RADIO, TELEVISION and HOBBIES

Volume 23, Number 7 **October, 1961**

VOICE FOR THE INDUSTRY

SITUATIONS, which have arisen recently, underscore the need for some truly representative council which can deliberate, co-ordinate and present the views of the electronics industry on questions affecting its welfare. At present, industry affairs are too frequently handled on a hit-or-miss basis by groups which either are not sufficiently known or supported, or which serve only narrow, sectional interests.

These are the situations to which I specifically refer:

- **Loss of VHF FM broadcasting.** Acting as it did, the present Government had the support of certain highly vocal interests. As we go to press, representatives of other equally large interests are getting together in a woefully belated effort to retrieve the position.
- **Lack of a Citizens' Band allocation.** Articles on this subject have been widely commended by all sections of our readership. Not a single objection has been raised. The industry clearly wants C.B. radio but it lacks the coherent voice to say so.
- **Television insurance and service.** Allegations are rife about certain "so-called" insurance organisations setting up in business with the most dubious possible motives and prospects. In vain, so far, have small sections of the industry called for Government intervention in respect to both technical qualifications and financial guarantees.
- **The need to build up exports.** Australia has an electronics industry more than sufficient for internal requirements. An export market is urgently needed but little initiative has been shown, thus far, in finding and exploiting external markets on an industry-wide basis.

It is one thing, of course, to state the need for a central council; it is quite another to suggest how it should be formed or constituted, without it becoming just another ineffective group, meeting at odd intervals.

My own feeling is that the task could best be undertaken initially by an "Industry Council" sponsored by the Institution of Radio Engineers. No other body, I can think of, commands such a representative membership, or such an objective appraisal of technical and business problems facing the industry.

To be sure, the I.R.E. has tended progressively to bury its head in the academic sand but the time may have come for it to assume a responsibility and set a lead in formulating policies for the industry on which it depends for its very existence.

W. N. Williams

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Editor:
NEVILLE WILLIAMS
M.I.R.E. (Aust.) (VK2XV).

Technical Editor:
PHILIP WATSON (VK2ZPW)
A.M.I.R.E. (Aust.).

Technical Staff:
KEITH JEFFCOAT (VK2BK)
JAMIESON ROWE
ALAN NUTT (VK2DN)
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Ext. 2531, 2525-6-7.

Advertising Offices:
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Broadway, Sydney. Phone B0944,
Ext. 2508, 2510.

Circulation Dept.:
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Cover Picture:

Photographed at the Rydalmere (N.S.W.) works of the Amalgamated Wireless Valve Company Pty. Ltd., our cover picture shows a process worker preparing dot assemblies for the transistor type 2N217, prior to forming the collector junction in the alloying furnace. The dot assemblies are arranged for firing in a graphite mould and given a final inspection with the large magnifying lens seen in centre picture. The work is done in a completely air-conditioned area, elaborate precautions being taken against dust, lint or moisture contamination.

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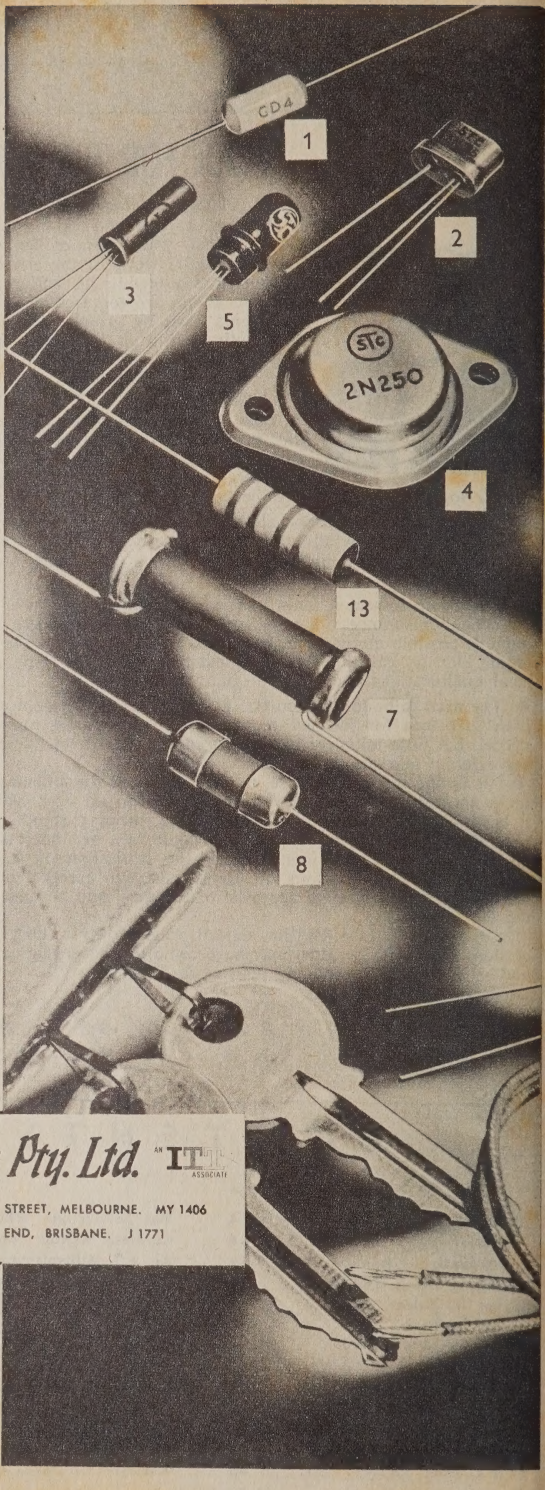

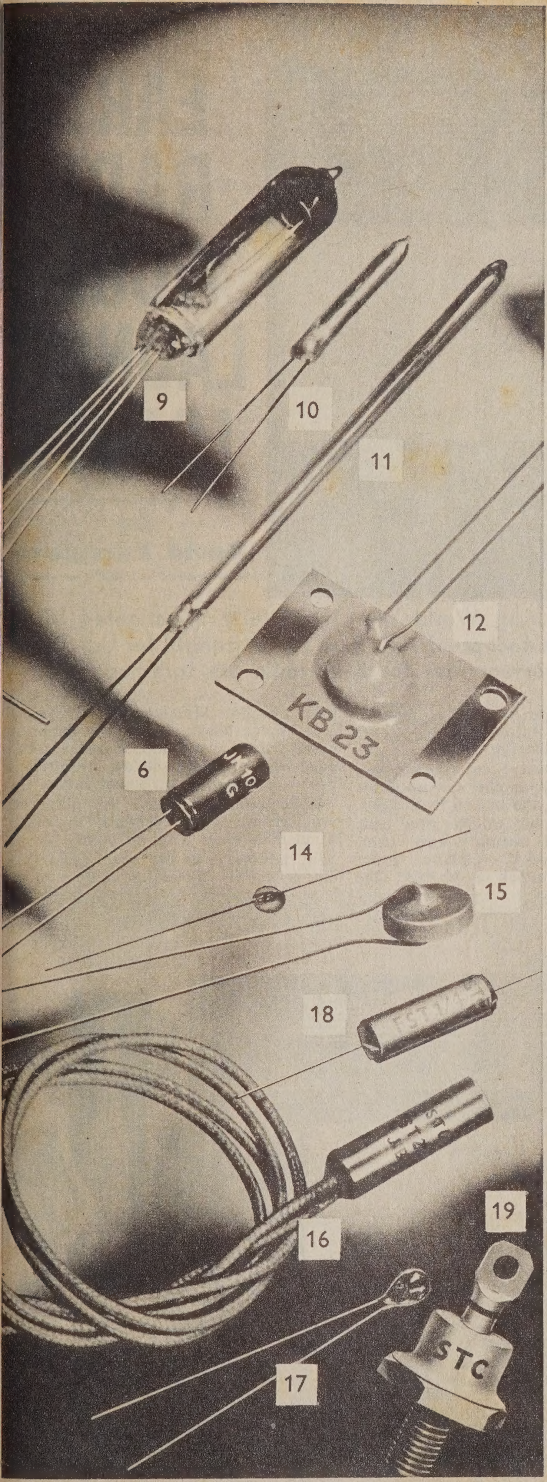

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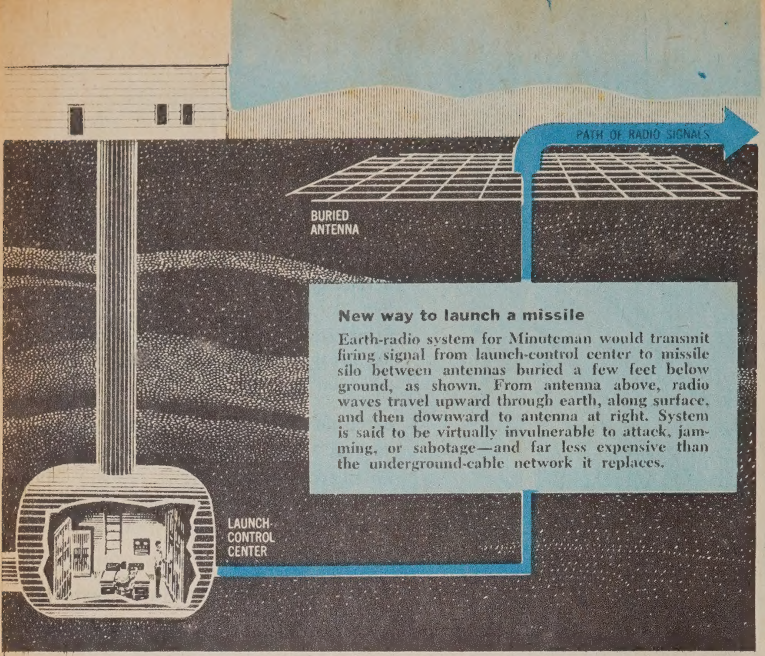


New way to launch a missile

Earth-radio system for Minuteman would transmit firing signal from launch-control center to missile silo between antennas buried a few feet below ground, as shown. From antenna above, radio waves travel upward through earth, along surface, and then downward to antenna at right. System is said to be virtually invulnerable to attack, jamming, or sabotage—and far less expensive than the underground-cable network it replaces.

HOW EARTH RADIO WOULD LAUNCH ICBM's

By
David Pursglove

A makeshift method of signalling, used during World War I and later investigated by Amateur Operators, is being adapted as a fool-proof system of launch control for U.S. Intercontinental Ballistic Missiles. Other important uses for earth-radio are foreshadowed.

IF the command to fire must ever be flashed to Minuteman missiles at the newest U.S. rocket bases, it will be transmitted by signals pulsing through the earth. The solid-fuelled ICBMs' launch-control system will employ a method of communication unheard of, until now, by the general public — underground radio.

This will be its first practical installation. Its principle, long known to scientists, was crudely applied in World War I and has been experimented with by radio amateurs. But it is only within the past three years that new researches have perfected the radical technique.

As applied for military use, "earth radio" works this way: Signals from an underground transmitter are emitted by a gridlike antenna buried a few feet beneath the ground.

They travel upward to the surface, and proceed along it —both in the uppermost few feet of earth and in the air just above. Then, descending again, the signals are picked up by a second buried antenna like the first.

Scene of an installation will be a missile base of the latest "hardened" type, designed to withstand a surprise hydrogen attack and still launch its missiles.

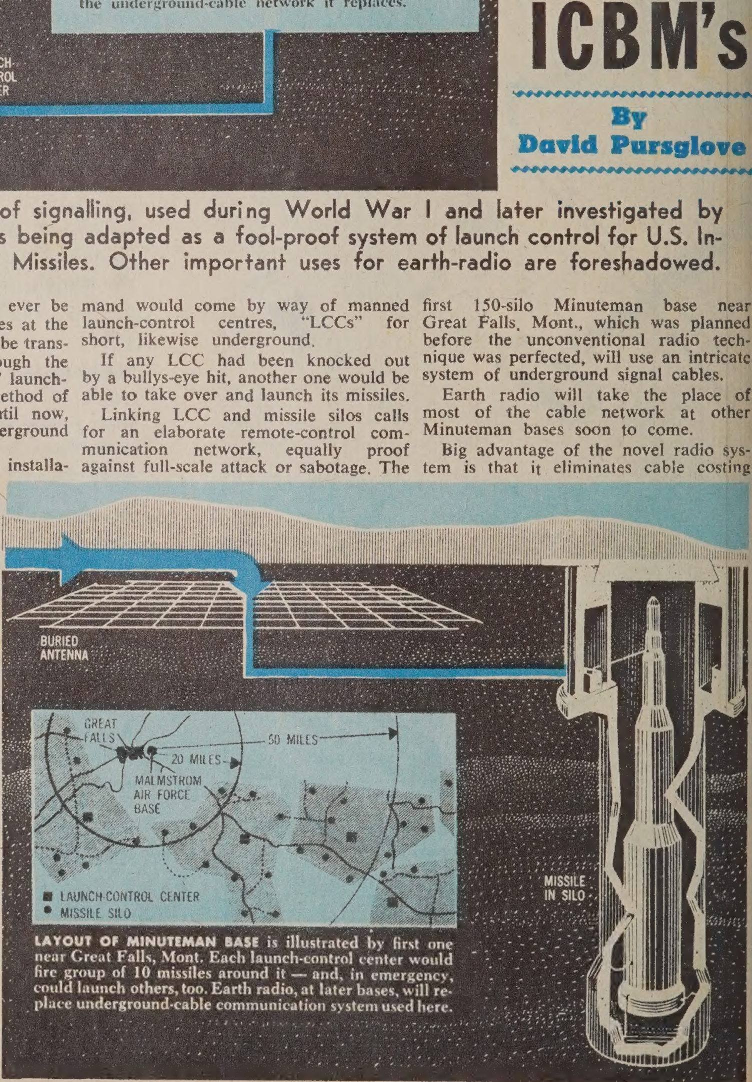
Out of sight below ground, the ready-to-go Minuteman ICBMs are poised in crewless, bombproof concrete silos, scattered widely about the countryside. The firing command would come by way of manned launch-control centres, "LCCs" for short, likewise underground.

If any LCC had been knocked out by a bullys-eye hit, another one would be able to take over and launch its missiles.

Linking LCC and missile silos calls for an elaborate remote-control communication network, equally proof against full-scale attack or sabotage. The first 150-silo Minuteman base near Great Falls, Mont., which was planned before the unconventional radio technique was perfected, will use an intricate system of underground signal cables.

Earth radio will take the place of most of the cable network at other Minuteman bases soon to come.

Big advantage of the novel radio system is that it eliminates cable costing



LAYOUT OF MINUTEMAN BASE is illustrated by first one near Great Falls, Mont. Each launch-control center would fire group of 10 missiles around it — and, in emergency, could launch others, too. Earth radio, at later bases, will replace underground-cable communication system used here.

20,000 dollars to 25,000 dollars a mile. That means a saving of about 300,000 dollars per missile, the Air Force estimates.

"We are convinced that the system is practical," says Lt.-Gen. B. A. Schriever, commander of the Air Research and Development Command. "It will be a virtually jamproof communication network, and highly invulnerable to sabotage."

While details are largely secret, this much more is revealed about the system: It will provide "a continuous report on the status of each missile" and of its silo. It will use "spread-spectrum" transmission, meaning that its radio waves will have a wide range of frequencies. This guards against deliberate interference; a prohibitive amount of power would be required to jam the whole range.

TO WORLD WAR I

The story behind the earth radio goes back to World War I, when the German advance on Paris cut off a French Army unit from its main force. The unit's signalmen, the tale goes, thrust two bayonets into the ground a few feet apart. They attached a buzzer, to serve as an oscillator, and had a crude wireless-telegraph transmitter.

Meanwhile the main body of French troops — following instructions from a runner who had got through—set up a similar receiver, using headphones instead of a buzzer. The "earth wireless" worked—and the code messages led to the rescue of the trapped men.

In later years, amateur radio experimenters have tinkered with the scheme. Instead of connecting his sending-receiving outfit to antenna and ground, an amateur would make one connection to a grounded water pipe—and the other to a metal rod sunk in the earth some distance away. Then he could exchange signals with another amateur, living nearby, who had done the same.

The trouble was, such experiments showed, that earth radio had a much shorter range than conventional radio — and took more power to span equal distance. So it remained just a scientific curiosity, until the coming of the missile age finally brought a use for it.

Development of Minuteman's shallow or surface-hugging system of earth radio began in mid-1958. Under an ARDC contract, experimenters of Space Electronics Corp., Glendale, Calif., conducted sub-surface trials under water and in a mine. Eventually they reported obtaining a strong signal more than 1,000 miles from a transmitter of 250-kilowatt power output.

SPECIAL ANTENNAS

Special antennas for the system were tested by the Boeing Airplane Company in earth-radio trials of its own, and transmitting and receiving equipment was developed by Sylvania Electric Products. The National Bureau of Standards also lent a helping hand.

Early last December, the Air Research and Development Command — considering the adoption of the earth-radio launch-control system for Minuteman — began a full-scale trial to confirm its practicality and reliability. In February of this year, the ARDC announced that it intended to use the system.

Meanwhile another kind of earth radio, called Lithocom, has been independently developed by an eastern firm. In contrast with the Air Force's "shallow" system, this is a "deep" one — its waves travel through subterranean rock without ever approaching the surface. Civilian applications, principally, are foreseen for it.

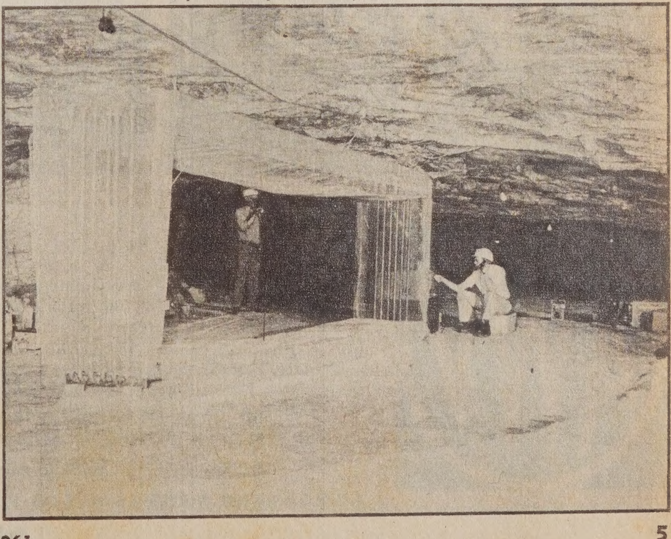
Lithocom was born in mid-1959, when recent geophysical studies suggested that deep-down radio was feasible. Although radio waves peter out comparatively quickly in deep rock, engineers of the Developmental Engineering Corp., Washington, D.C., theorised that their range could be greatly extended by taking advantage of favourable rock formations.

In the earth's upper crust, for example, a dry layer of sedimentary rock bounded by moist conducting ones should form a natural "waveguide" or conduit for subterranean radio waves. And so should a readily available "laboratory model" — a natural underground bed of salt, with an overburden of more-conductive rock.

Ready for actual trials by February, 1960, Deco engineers invaded two mines near Carlsbad, N. M., that had offered to co-operate. They set up their transmitter in an abandoned portion of the Potash Company of America workings, where the ore had become too thin to mine—an ideal place to work undisturbed. Their receiver went into a tunnel of the U.S. Borax and Chemical Company mine.

Success rewards experimenters, as a radio-teletype message travels a record 4½-mile distance through the earth, at a 1,000-foot depth, from the equipment shown above to a similar installation in another mine. This work confirmed the possibility of ducting signals through earth layers.

Made up from pipes and chicken wire, this is one of several underground radio antennas which Deco engineers tested in their efforts to transmit radio signals between points located deep in the earth's surface. The work may have important implications for the future.



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AWV

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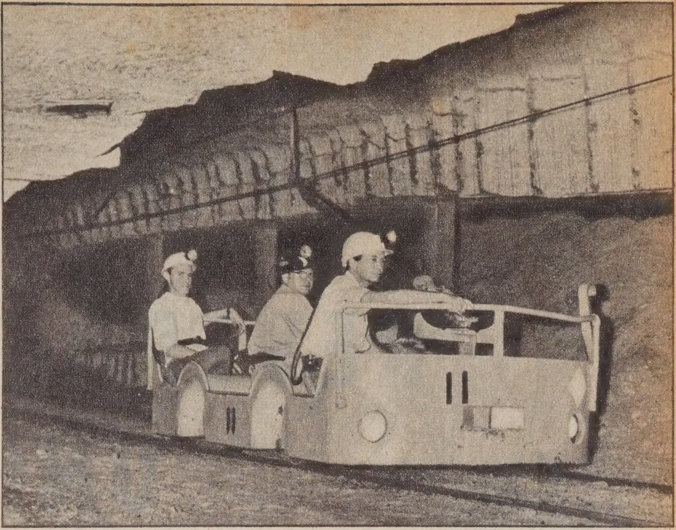
At the start of their day the electronic engineers could truthfully say, "Well, back to the salt mine." They reported at 7 a.m. with the first mining shift, rode three miles underground by narrow-gauge railway — and still had a half-mile walk, through a passage only 4½ feet high, to their transmitting test site.

The reddish salt of the mine walls made cuts, scratches, and closely shaven faces sting. Taking so long to reach their location and return, the engineers had to stay during two mining shifts; usually they returned to the surface with the swing shift at 11 p.m.



"Back to the salt mine" was an appropriate phrase for these radio engineers, riding to work through the tunnel of a potash mine near Carlsbad, N.M. Necessity to co-ordinate their movements with regular mining activities meant a 7 a.m. to 11 p.m. day.

FIRST SIGNAL

On July 28, 1960, after numerous attempts, the first signal was successfully transmitted. It travelled a record 4½ miles, at 1,000 feet depth. The feat was performed with a radio-teletype circuit, and a low-power transmitter operating at less than 200 watt output. With more power, Deco engineers say, voice transmission and 100-mile range would be feasible.

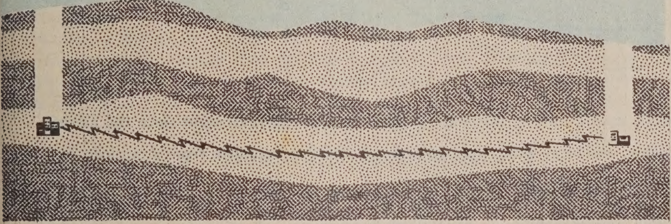
For the Lithocom system of earth radio, the Deco engineers see many possible applications.

Installed in a large mine, a communication system of this kind could aid everyday operations — and, in an emergency, speed mine-rescue work.

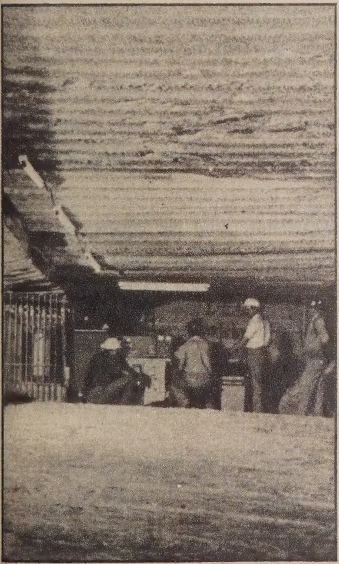
The shielding effect of overlying earth makes the Lithocom system virtually noiseless. Therefore, it has interesting possibilities for supplementing more-conventional channels of communication wherever static from electrical storms or man-made electrical noise interferes with their use.

Finally, the engineers note, the alternating wet and dry layers of the earth's crust offer multiple paths for Lithocom channels. Even on the same frequency, messages could be transmitted through different rock belts without interference between them.

Will the answer to the problem of overcrowded air waves be to detour radio traffic through the earth? So new is earth radio in its first practical forms that it is still too early to foresee how far this development may go.



In the Lithocom earth-radio system signal passes along natural wave-guides formed by dissimilar layers in the earth's structure. Parallel layers can carry signals on the same frequency without mutual interference.



Surely the strangest place ever in which to transmit radio signals— at the end of a mine passage and facing a blank wall of solid earth.

CONVAIR 990 CLOSE TO MACH 1

A CONVAIR 990 Coronado jetliner has flown within three per cent of the speed of sound — faster than any other passenger transport in the world. Scandinavia Airlines System and Swissair, who have purchased Coronados for the route networks, said the jet achieved a true air speed of 675 miles an hour during recent test flights.

This is 100 miles an hour faster than the average speed achieved by the R.A.F. Vulcan jet bomber which made a record-breaking non-stop flight from the U.K. to Australia during June.

The jetliner was at an altitude of 22,500 feet and flying over the Pacific Ocean near San Diego, California when it reached the record speed of Mach .97—or within three per cent of Mach 1, the speed of sound.

S.A.S. and Swissair plan to put the 990 into service early next year to South America, Africa, and on the southern route to the Far East.

Announcement of the record-smashing flight was delayed until an exhaustive analysis had been made of all the flight data. Mr Don Germeraad, Convair's chief engineer test pilot, said that the 990 Coronado handled easily at the high speed achieved due to the effect of the jetliner's "speed capsules."

These capsules—two on the upper surface of each wing—are shaped like inverted canoes, and serve to carry the air flow smoothly away from the wing. The capsules are 24 feet long, and two feet wide at their greatest diameter.

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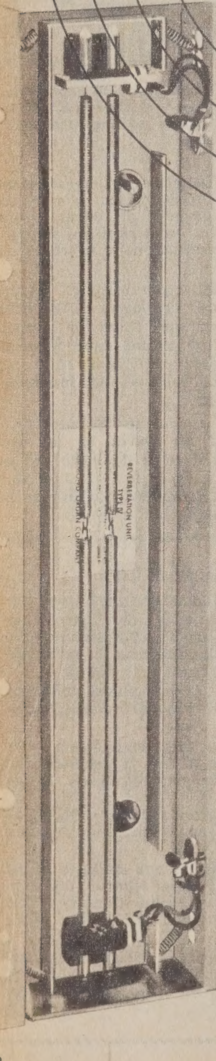

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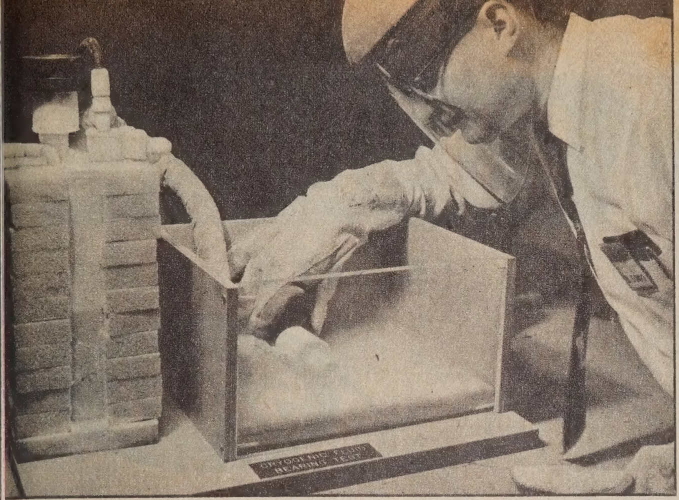


Temperature means little to AIR BEARINGS

Some 5,000 years ago when a spear-carrying Persian soldier first smeared a fistful of animal fat on the axle of his war chariot, he neither knew nor cared that he was initiating the history of bearing lubrication. From this somewhat earthy beginning, wheel and other bearings have used a multitude of lubricants, until today the shafts in certain bearings literally float on air.

By Donald Brannon

ALTHOUGH air bearings (sometimes called gas bearings) have been known for several years, until now drawbacks have prevented their widespread use. Today a new concept developed by C. R. Adams, research engineer of Boeing's Aero-Space Division physics technology department, has cleared the way for long strides ahead in air-bearing applications. Further investigation and analysis have been conducted by Juraj Dworski and E. M. Shoemaker, the latter now teaching at the University of Illinois.

For simplification, descriptions in this article will be of vertical-shaft thrust bearings. Air bearings also may be used on horizontal shafts for radial loads.

Air bearings are of two principal types. The self-activating type has a correctly engineered space between the shaft and the housing. The shaft spins at very high speed and air pressure builds up between shaft and housing, preventing metal-to-metal contact. Riding on a cushion of air, the shaft spins freely with minimum friction. This type of bearing has small load-carrying ability.

The externally pressurised type of air bearing can carry a much greater load. In an old design, pressurised air from an outside source is injected through evenly spaced orifices in the housing. This air becomes a low-friction cushion between shaft and housing.

The new bearing developed by Boeing has an entirely different design. Compressed air flows through a single opening into a recess between the rotating shaft and its housing. This recess is a shallow, flat depression in the bottom of the shaft, leaving a rim, or step, around the edge. Air pressure under the cupped shaft bottom lifts the shaft free of its base and the shaft spins on a cushion of air.

In operation, the recess traps a cushion of air which is only large enough to meet load requirements. Air flow is throttled at exit, rather than at inlet, as with orifice-type bearings.

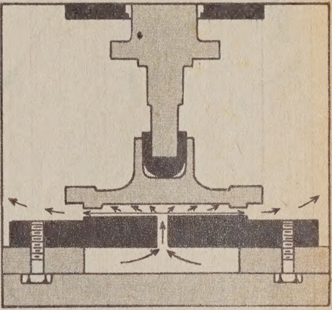
Boeing air bearings—often called step bearings — offer several improvements over orifice types. The new bearings are simpler and less expensive to produce. The single air inlet can be drilled with standard equipment and requires much less precision than drilling tiny orifices in the housing. Complex airflow-control apparatus is not required for the step bearing.

The step or rim on the end of a shaft may be made by plating or by machine or chemical milling. Boeing step bearings damage less easily than orifice types and can be designed to have self-activating characteristics at high speeds.

If our Persian soldier could be lifted from the past to compare the performance of his animal fat with air lubrication he would be flabbergasted. Air-bearing shafts ranging from half-inch to five inches in diameter have been used, with wider variations feasible. Shafts have run at speeds up to 100,000 r.p.m. Ambient operating temperatures of 600 degrees F. have been used and successful operation at 1,000 degrees is expected.

Ability of the new bearings to convert from external pressurisation to self-activation makes them feasible for hermetically sealed electric motors in space vehicles. Good temperature distribution within the bearing is another advantage.

In high-speed turbines where elevated temperatures are a problem Boeing air-lubricated bearings can be used to advantage. They are expected to fill a vital need also in nuclear-energy applications where radiation damages grease or oil lubricants.



End thrust is borne by a layer of pressurised air. At top left, Boeing's C. R. Adams demonstrates a step type journal bearing, operating with nitrogen cooled progressively until it turned from gas into a liquid.

In the paper and food-processing industries air bearings can eliminate contamination due to leaky or damaged seals, while in the machine-tool industry air bearings offer improved high-speed drilling and similar capabilities.

Finally, air bearings possess valuable potential in low-temperature pumps handling such materials as liquid oxygen and nitrogen, where intense cold makes glue of normal lubricants.

The capabilities of the new-design air bearings have been recognised by Boeing Associated Products. This organisation is prepared to license manufacturing rights to equipment manufacturers and specialists in the bearing industry — an important industry started by a warrior with a fistful of fat.

PYE TELECOMMUNICATIONS announce that, with the opening of the London Minicab Scheme, they put into operation for Welbeck Motors the largest radio-telephone system in Europe. The installation opened with 200 radio-taxis but will expand to 800 by the end of the year.

The system has been planned with six-channel radio-telephone equipment installed under the dastboard of each car and giving communication over a radius of 20 to 25 miles of Piccadilly Circus.

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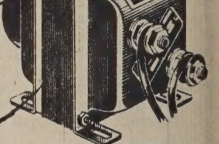

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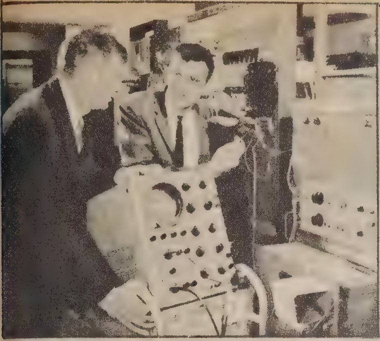
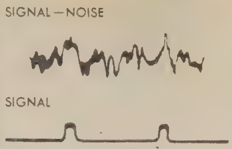




Dr. Charles V. Jakowatz, at right in the photo, points to the adaptive filter, as laboratory assistant Robert R. Gilbert looks on. In right foreground, the recorder for the output signal. Above, oscilloscope traces show a typical input signal buried in noise, together with the signal alone.

SELF-ADAPTIVE FILTER

seeks out signals buried in noise, adapts automatically to signal changes

THE development of a system for detecting and classifying unknown or concealed signals was announced recently by the General Electric Research Laboratory. "The new system has detected signals buried in random noise that could not be detected by trained observers, even when they knew what to look for," according to Dr Guy Suits, vice-president and director of research. "Moreover, the system can detect these buried signals even when their full characteristics are previously unknown, and in the process of detection it determines those characteristics," Suits added.

"With but limited prior knowledge of the characteristics of the signal it is supposed to detect," according to Suits, "the system can, with experience, separate the signal from the random noise in the input data. It does this by associating those elements of the input data which are similar, and modifying itself to detect optimally these similarities," Suits said.

Details of the system, which is called "adaptative waveform recognition," were first presented on September 1, 1960, at the fourth London Symposium on Information Theory at the Royal Institution, London, England. The system was developed by Drs Richard L. Shuey, Charles V. Jakowatz and Gerald M. White, of the Laboratory's Electron Physics Research Department.

Experiments conducted by General Electric scientists demonstrate the novel characteristics of the new technique. Initially, the filter receives an input consisting solely of Gaussian noise of constant mean value, which does not pass. Then a signal is introduced in combination with the noise. For one typical experiment the signal consisted of negative M-shaped pulses of about 7 milliseconds' duration and repeated 30 times per second, but at intervals randomly spaced in time.

senses new signals

Within a few seconds after the first signal pulse appears the filter begins to alter its response. Within a few more seconds the filter is fully adjusted to the incoming signals and passes them. If and when the signal disappears the filter automatically returns to its no-pass condition. To this point the potential of the filter is not unduly impressive, because the same results could be achieved by a conventional filter matched to the particular signals involved; this assumes, of course, that the signal characteristics are known beforehand.

But suppose the waveform of the signal's pulses is radically altered to a different configuration, of different duration, repetition frequency and signal-to-noise ratio. Without any change in the self-adapting filter circuitry it will automatically sense the new signals and adjust itself to pass the new waveform. If it were desired to pass signals of two or more different waveforms simultaneously this could be done by using two or more self-adaptative filters, suitably interconnected to secure a divergence of selection.

Internally, the self-adaptative filter has a memory circuit in which it stores its current estimate of the significant characteristics of the incoming signal. This estimate of signal characteristics stored in the memory gradually decays unless it is reinforced periodically. (In the experimental filter memory, time constant was about 20 seconds, but the optimum value would depend on the anticipated use.)

The filter compares continuously its memory's estimate of the incoming signal characteristics with the input to the filter. Where it finds reasonable similarity (correlation), the estimate of signal waveform stored in the memory is reinforced. When the input to the filter is solely Gaussian noise (no signal) the estimate of the signal stored in the memory is completely random, like the noise. This means that there is no periodic correlation and, therefore, no effective reinforcement of signal estimate in the memory.

Applications of the system are expected to be primarily in the various detection and classification areas involved in defence. A number of applications in the general area of information handling may be possible through special adaptations of the system.

FILTER ANALOGY

PRINCIPLE of operation of General Electric's recently developed adaptive filter, and the way in which its operation differs from a conventional matched filter, can be illustrated by the following analogy, reprinted from "Aviation Week": —

Suppose that an orchestra is to play for a very exclusive party at which many gate crashers are expected to use any ruse to gain entry. Entrance through the stage door is controlled by a guard of extremely low mentality, corresponding to a filter in an electronic circuit.

If each member of the orchestra is given a special pass for the occasion, and if the guard is given a copy of the pass and told to admit only people bearing such passes, then the situation is analogous to a matched filter in which the guard/filter has advance knowledge of the identification of person/signals to be passed.

Suppose, however, that it is learned that gate crashers have made counterfeit passes and the guard is told that he must therefore attempt to size up each individual seeking entry to determine whether or not he is a musician.

The guard starts out with the initial assumption that the musicians will be carrying an instrument. This is not a sure criteria since the drummer and piano player will not, and some gate crashers may be carrying instrument cases.

But like the adaptive filter, the guard has a simple memory and he can make use of feedback.

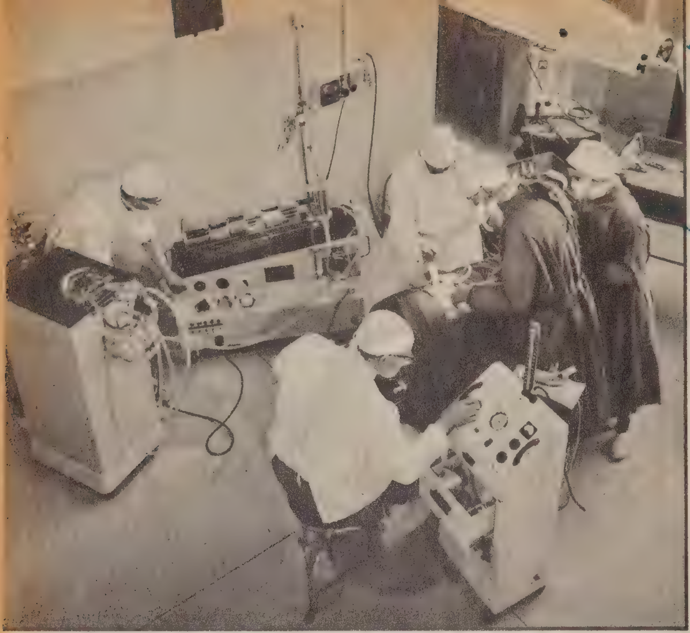
He knows that each time he admits a person that is indeed a musician, he should hear one more musician tuning up on stage seconds later.

The first man to seek entry is carrying a black case and a pass, so the guard decides to risk admitting him. A few moments later he hears a trumpet player tuning up on stage and decides that he made a wise decision. Moments later another man appears with an instrument case and pass and the guard admits him. Shortly afterward the guard hears a violinist tuning up and decides that these two criteria — an instrument case and a pass — are the significant marks of a musician.

But next there appears a woman, also carrying a pass and instrument case, so the guard admits her. But he waits in vain for the sound of a third musician tuning up and finally decides he's been fooled by a gate crasher. He therefore modifies his admittance criteria to add the requirement that only males will be allowed entry.

When a 12-year-old boy appears, with instrument and a pass, he meets the guard's revised admittance criteria and gains entry. But again the guard waits in vain for the sound of a third practising musician and then decides the boy was another gate crasher. Again the guard revises his admittance criteria. This time he resolves to admit only adult males carrying instruments and passes.

Through this process of learning, and adapting, with the aid of feedback and memory, the guard soon develops an admittance criteria which enables him to discriminate between musicians and gate crashers with a moderately high degree of success. By a somewhat similar process, the adaptive filter learns to discriminate between noise which it should block and signals which it should pass.



Looking down on the operating theatre of a London Hospital, with equipment grouped for a heart operation. At left is a heart-lung machine developed by Dr D. G. Melrose. The machine was exhibited recently at the Sydney Trade Fair.

Operating Inside The Human Heart

Of all the intricate organs in the human body, the one which defied surgeons the longest was the heart. But modern techniques, including a high proportion of electronics, have made it possible to operate on — and inside — the heart to rectify conditions which, up till recently, could only have spelt death to the patient.

By Calvin Walters

WHILE it has normally been reckoned that interference with the heart could mean only instant death, it must be admitted that there have been notable cases over the centuries where people who have suffered heart wounds, notably in duels, have lived long enough afterward to tell the tale.

One case is on record where a man completely recovered after having been stabbed through the heart with a rapier.

No doubt his opponent in the duel considered this most unfair, but whether the duel was resumed in order to reach a decision is not recorded.

The fact remains that, according to medical knowledge at that time, the man should have died within a few minutes of the stabbing.

In those days, to open a man's chest and tinker around inside was unthinkable. Operations were limited to much less critical parts of the body. Legs and arms were sawn off or mended, but even these ventures were accompanied by great peril to the patient because of the lack of knowledge of anaesthetics and of antiseptics to combat the activities of bacteria.

It was not until the year 1867 that the great Lister thought of carbolic acid to kill germs, making surgery much less risky.

Nevertheless, it was not until 1879 that surgeons took the risk of operating on the internals of the human body, when a surgeon joined together the stomach and small intestine of a man in order to make communication between them.

From then on, thanks to increasing knowledge of antiseptics, the process of sterilisation of instruments and accessories and to the discovery of anaesthetics, surgery made great headway and most parts of the body became operable.

However, the heart, although accessible, was still an organ which no surgeon was courageous enough to touch because of the belief that it would stop immediately it was interfered with.

It was not until early this century that any attempt was made to operate on the heart. Since then, particularly during the past 20 years, improved techniques have lessened the hazards of such operations and many people have been saved from death or had their span of life increased by rectification of defects in the heart's functioning.

If the heart stops for any reason at all, death normally occurs almost immediately. In such cases the brain is the first organ to die, for it cannot live without blood for much longer than four minutes.

In order to understand the difficulties of heart operations and to see the meaning of modern techniques let us have a look at the anatomy of the heart.

It is divided into halves by a wall called the septum, which is made of fibre and muscle. The halves are again divided into two compartments of left and right. These compartments are called the left ventricle and auricle and the right ventricle and auricle.

The ventricle and auricle in each half are connected by an opening which is furnished with a valve.

These compartments and valves, together with associated veins and arteries connected to the heart from various parts of the body, work in the manner to be described.

Let us suppose that the heart is at rest and that the whole circulatory system is full of blood. Let us suppose now that the heart is set in motion. This is what happens:

The right ventricle forces the blood into the blood vessels of the lungs, where it becomes charged with oxygen. It flows then into the left auricle, from whence the beating heart forces it into the left ventricle and on through a large artery, called the aorta.

From all the branches of the artery the blood is forced to various parts of the body, where it gradually loses its oxygen. It then flows back through the veins to the right auricle, where the cycle starts all over again.

The heart itself requires an unfailing supply of blood to keep it going. It gets this from the first part of the aorta.

The heart, as a whole, is enclosed in a thick, tough membrane called the pericardium. This is of some importance to our discussion.

The heart pulses or beats by alternate contractions at the rate of about 70 to 80 beats per minute. This varies at times, increasing with excitement such as at the sight of food, a bottle of beer, winning a lottery, hiding from the taxation inspector, lying to the wife about working back or at the sight of an attractive female.

I am also told that really hard work

increases the rate, but I wouldn't know about this.

This pumping of the heart forces all the blood of the body through the heart every 23 seconds.

If the heart is wounded, blood escapes and cannot reach the brain and other vital parts of the body. Instead of being forced into the aorta the blood escapes into the pericardium, which is dilated by the pressure of blood.

The pericardium contains a large number of sensory nerve endings which are intensely excited by the pressure of the dilation. The impulses set up are transmitted to the brain, which in turn sends messages to the vagus nerve.

Now the vagus nerve has a lot of branches, some of which spread into the heart. The vagus nerve is a nerve of inhibition so that the nerve inhibits the heart muscle which ceases to contract and the heart stops beating. Then "curtains."

You can see now why all those fellows on TV westerns never recover from their gunshot wounds.

You can also see why operations on the heart are difficult. Firstly, the heart is in a constant state of motion. To operate on something which won't stand still for a moment is a major project. Secondly, the blood supply to the brain and body must be maintained throughout the operation. Blood must also be supplied to the heart for without it the heart would be damaged beyond repair.

One of the most intricate operations now being performed on the heart is the so-called "hole in the heart" operation.

STRUCTURE OF HEART

It will be remembered that the heart is divided down the centre by the septum. This wall acts as a barrier between the left and right half to protect the right half and the blood vessels against the high pressures which are developed in the left side of the heart.

If the septum is penetrated with a small hole the high-pressure blood in the left side forces through the hole into the right side, where it transmits high-pressure blood into the lungs.

This high pressure, which is exerted on the walls of the blood vessels of the lungs, causes a reaction, exhibited by thickening of the blood-vessel walls.

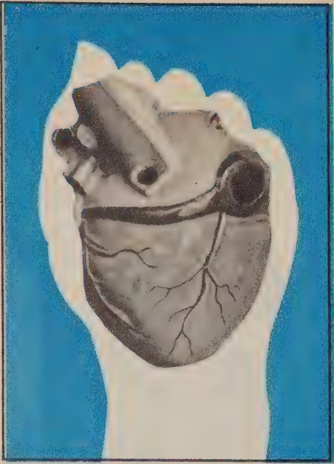
The walls become so thick over the course of time that the blood flow hrough them is greatly reduced, finally ecoming blocked, with consequent ailure of the heart.

The only way to fix the trouble is to lose the hole in the septum. Imagine his being done while the heart is beat-ng furiously. There is only one way o the septum. That is through the eart itself.

The various techniques which have een developed over the past few years re used according to the type of opera-ion which has to be performed on the eart and the length of time required o carry it out.

The great obstacle to "open heart sur-ery" is the fact that the function of the eart cannot be interrupted for more han a few minutes without grave risk o the patient. Although many parts of he body can do without a blood supply or comparatively long periods, the brain annot survive for more than four min-tes. After this there is grave risk of eath or at least serious mental damage.

If the heart is doing no work, its own muscle may be deprived of blood supply for about 20 minutes.



The average person's heart is about the size of their own clenched fist, although variations do occur.

Modern techniques, therefore, have been designed along two lines of endeavour. Firstly, to find a means of slowing the heart's action without completely stopping it, and, secondly, to stop the heart and use some artificial means of supplying blood to the brain, heart and body.

Obviously a stopped heart, drained of internal blood, is the ideal solution, for operations on a dry heart could be carried out much easier.

The slowing down of the heart's action was achieved in 1950 when it was discovered that if the body temperature was reduced below normal the supply of blood could be cut off from the heart for more than twice the usual time. It was also found that at below-normal temperatures the brain requires only about one-fifth of the normal supply of oxygen, which it derives from the blood.

From this knowledge the process called "hypothermia" was evolved. It is commonly called "frozen sleep."

Hypothermia can be likened to the hibernation of animals. In hibernating animals the body temperature falls close to that of its surroundings. Safe in its burrow it can sleep throughout the long winter because its heart, its respiratory rate and all its other bodily processes slow down to about two per cent of normal.

In animals the mechanism which reduces the body temperature is "built-in." The human being has no such mechanism, although it may be popularly supposed that in departments responsible for public works there are numerous exceptions to this statement.

BODY TEMPERATURE

In hypothermia the body temperature is reduced to about 84 degrees by one of two methods.

There is an internal control in the human body which keeps the body temperature at about 98 degrees. This has first of all to be put out of action by means of a special anaesthetic.

The patient is then wrapped in a double-walled blanket through which water is flowing at a temperature of 37 to 41 degrees F. The patient's body gradually reduces to the desired 84 degrees, when the chest is opened and clamps applied to the arteries which supply blood to the heart. The heart thus becomes dry and can be operated upon without blood surging all over the cavity of operations.

The advantages of such a procedure will be apparent.

Not only can the surgeon see what he is doing but there is less risk of brain damage because that organ can do with much less oxygen at such a low temperature.

Another method is a selective one in which either the brain can be cooled to a temperature below that of the rest of the body or the body can be uniformly

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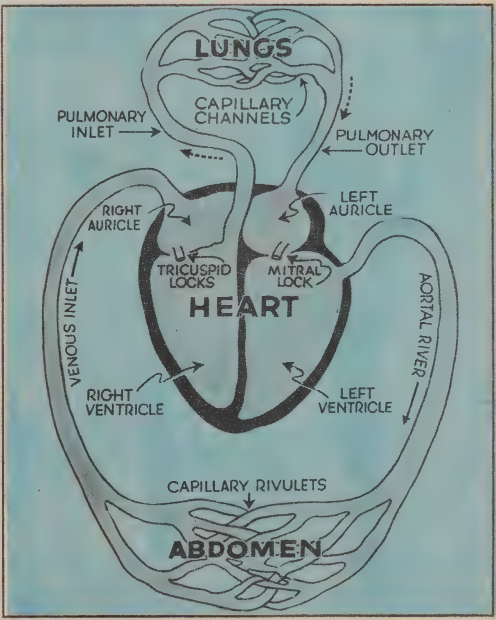
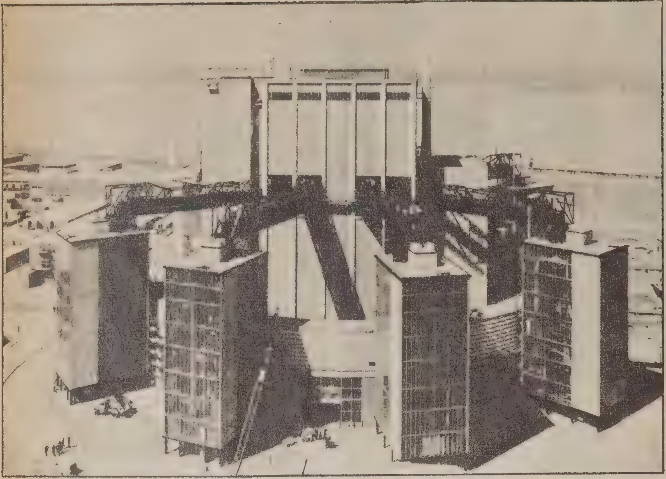


Though not by any means complete, this diagram shows the general path followed by the blood from the heart, through the lungs and back to the heart, out through the body and limbs, then back to the heart again, to complete the circuit.

275 MW. ATOM POWER STATION



At Berkeley, Gloucester, on the estuary of the river Severn, Britain's Nuclear Power Group is building a 275 Megawatt nuclear power station for the Central Electricity Authority. The station is due to be completed and producing power by the end of 1961. The picture above shows the number 1 reactor nearing completion. Below is shown the control room.

HEART—[Continued]

cooled to whatever temperature is considered safe.

The carotid artery is located in the neck. Through it blood passes to the brain. By putting a clamp on this artery and placing a tube in the artery above and below the clamp the blood is by-passed out of the body through tubes, which convey the blood through a cooling coil and back into the body. By this method the brain can be cooled to about 20 degrees below normal.

At this temperature the circulation can be stopped for up to 15 minutes without brain damage.

If the same procedure is applied to the femoral artery located in the thigh, general body temperature is reduced in a similar fashion to placing the patient in a cooling blanket.

When the operation is over the patient is warmed up again in the same blanket by passing warm water through it.

If the body temperature could be safely lowered below 84 degrees the time for the operation would be prolonged. However, at a temperature of 80 degrees the heart suffers with what is called "ventricular fibrillation." This is a disorganisation of the heartbeat where the ventricles develop extra beats and bursts of unco-ordinated contractions.

Finally the whole heart is contracting in different places at the one time and heart failure results.

When this occurs the surgeon has to stop the heart and restart it either by squeezing it rhythmically at 70 to 80 times a minute or by means of a machine operated electrically, called an electric pacemaker.

The surgeon squeezes the heart until he forces enough blood into it to restore its pink colour. The electrodes of the machine are then applied to both sides of the heart and short shocks of 110 volts are applied. This stops the fibrillation and the surgeon restores the rhythm by massage, or regular electric impulses are delivered by the machine to rhythmically contract the heart to 80 pulses a minute.

Another method used for open heart surgery depends on the use of the "heart-lung machine." This is a machine which "stands in" for both the heart and the lungs.

The principle of this machine is simple. The blood is diverted out of the heart through tubes connected to the arteries in such a way that the heart is by-passed. But blood must not only be oxygenated, it must also be made to give up its carbon dioxide.

This is done by passing the blood over screens in a special oxygen chamber before it is passed through the body again. In this way the heart is made "dry" whilst the brain and body are supplied with a normal supply of blood during the operation.

In addition to by-passing the heart and lungs by means of the heart-lung machine, there is a technique where the heart is stopped completely. This not only provides a dry heart but also a quiet heart for the surgeon to operate upon. This is about the ultimate in surgical requirements.

STOPPING THE HEART

Heart-stopping is achieved by injecting into the base of the heart in the vicinity of the aorta a small quantity of potassium citrate. In less than a minute the heart has stopped beating and the heart-lung machine carries on in its place. On removal or dissipation of the potassium citrate the heart resumes beating.

Experience gained with the heart-stopping technique has proved that it must be used with discretion, as it has some disadvantages.

For instance, in the process of stitching the hole in the heart or the wound made by the scalpel the surgeon must see instantly whether the needle has touched one of the nerves which govern the heartbeat. He can do this with a moving heart and thus stitch in another spot.

With a quiet heart he cannot see this at all until the heart starts beating again. He then may have to undo the stitches and start all over again.

With some kinds of congenital heart disease the difficulty of starting the heart again is greater if it has been stopped for more than about half an hour.

The heart-stopping technique is therefore used only when no other course will do, such as when very delicate surgery is required or when the defect is difficult to reach.

One of the outstanding achievements of modern medicine is the discovery of the use of the drug curare for relaxing muscles of the human body. This drug is that used by the South American Indians for poisoning their arrows.

Modern derivatives of this drug, such

(Continued on Page 111)

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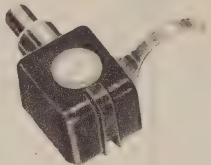

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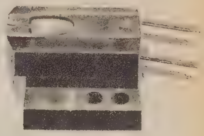

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The SPU stereo pickup is now also available as a cartridge to suit OTHER pickup arms and shells.

The new ORTOFON Stereo Pickup Cartridge SPU sets superlative standards of reproduction, free from compromise, cross-talk or distortion. Just like the type "C" or "A" mono cartridge, the stereo SPU cartridge can be mounted in ORTOFON shells type "G" or "A".

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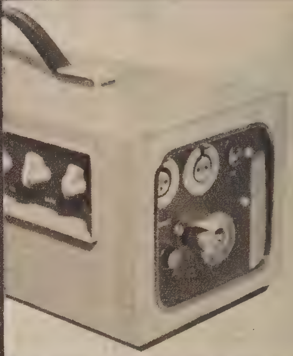

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Technical Review

BRITAIN ARGUES ABOUT TV COLOR, STANDARDS

The question of color television is being hotly debated, at present, in Britain. The B.B.C. has been pushing hard to commence colour transmissions on present standards. The Authorities are inclined to the view that, if and when color is introduced, it should be on a new 625-line standard. The following comments are reproduced from a recent copy of "TV Times."

"Color within two years" says V. J. COOPER

B.Sc.; A.C.G.I.; M.I.E.E.; M.Brit.I.R.E.; Immediate Past Chairman, Television Society; Member Technical Sub-Committee, Television Advisory Committee.

WHEN are we going to get colour? This is a question I am asked with unfailing regularity when I discuss television with the average viewer.

Until a year or two ago my forecast was "at least five years and maybe nearer 10" but during the last two years the situation has been changing.

Japan, following the American lead, has begun colour television, so have the Russians. East Germany is preparing for an early start and industrial, commercial, scientific and medical users of television are turning their attention to colour. This new atmosphere persuades me to be more optimistic in my forecast.

ITV and the B.B.C. are prepared to broadcast colour television, and colour cameras developed in this country are available to do so. Moreover, transmitters designed for colour have been supplied. Why then is permission to go ahead not forthcoming?

There are several reasons for the delay, the most important being that, ironically, because we were first in the world with a television service, we now find ourselves out of step with the rest of the countries with television.

Our 405-line television pictures are not easily interchangeable with European television pictures which use the 625-line system and the problem of interchange becomes more difficult with colour. Discussions are in progress on the Pilkington Committee on Broadcasting to decide whether we should adopt a 625-line system.

With this possibility of change, many people argue that colour should not be introduced until a decision has been reached on future standards — 405 lines or 625 lines. As soon as the decision has been taken, then colour could theoretically be introduced without much delay.

If it is decided to adopt 625-line standards in this country, and to have colour only on the new transmissions, it will take many years before 625-line pictures, in black-and-white or colour, can be received by the 97 per cent of the population now able to get television.

This is because additional programs using 625 lines will have to be broadcast in an entirely new band of frequencies — ultra high frequencies.

To cover the country at these ultra high frequencies will require a hundred or more transmitting sites and these are likely to take many years to acquire and equip. This would, of course, be a gradual process and the centres of large population might expect priority and get service within two or three years.

If, on the other hand, it is decided not to change standards, then the introduction of colour on a countrywide basis is simplified and could be achieved almost without delay.

Whatever scheme is adopted, however this is only half the story. Even if colour programs are broadcast, how will the viewers receive them in their homes?

"TV TIMES" sums up the facts:

EVERYONE, almost without exception, wants colour television in Britain. There is no doubt about that. What causes all the arguments is HOW and WHEN it should all come about.

It is worth remembering, however, that expert opinion on the subject differs widely, even on apparent matters of fact. One thing that is sure is that there is no magic switch waiting to be thrown that will flood your home with colour television tomorrow.

Undisputed facts on the subject are few. But we do know:

When colour television begins, 21in sets are likely to cost at least £200 sterling. At present anyone can order a British-made set for £1,500 to watch experimental colour television transmissions.

In AMERICA, where colour television is seven years old, fewer than one set in 50 is a colour receiver. This year the main colour network, N.B.C., has been presenting 32 hours of colour TV a week. The two other major networks, C.B.S. and A.B.C., have not moved into national programming and say they will not until they feel "the public is ready for it."

An American colour TV set can now be bought for about £180 sterling. This is less than half the cost when they were introduced in 1954, but still three times the cost of present black-and-white sets.

In JAPAN, where colour was launched less than a year ago, the leading colour television network offers five to six hours' programming a day. There are 7,000,000 sets in the country, of which 4,000 are colour sets. In addition, there are a number of demonstration models in hotels and business houses. The leading colour set manufacturer intends to increase production from 300 to 1,000 sets a month this year.

In RUSSIA, colour television is still in the experimental stage. No date has been set for the introduction of a domestic colour TV service.

Cost apart, servicing and repair of colour sets will be a big problem.

There is already a great shortage of qualified technicians. Even now double the present 6,000 are required and the vast majority of them all will then have to be trained in colour TV servicing.

The whole question of colour television in Britain is under review by the Pilkington Committee on Broadcasting, which is expected to submit its report next year.

On these pages you can read the opinions of two of Britain's leading television experts, L. H. Bedford and V. J. Cooper.

PLANNING A SOUND INSTALLATION

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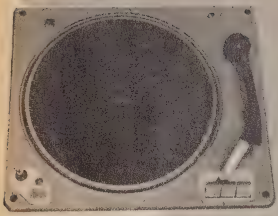
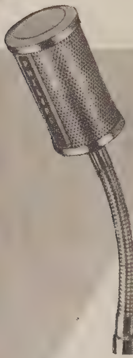
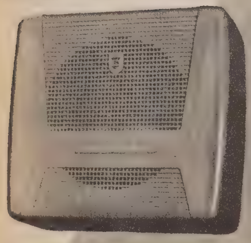


Model AG2005YS.

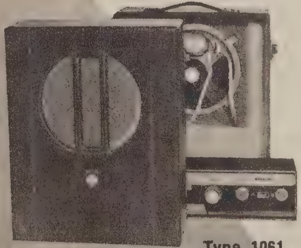


Model EV4304.

Model EV4650.



Model EV4500.



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On our ordinary black-and-white sets, the colour transmissions will appear as normal black-and-white pictures and there is no simple way of converting a black-and-white receiver to colour. The viewer, therefore, must buy a new receiver which will display colour as well as black-and-white pictures.

Such receivers are in production in the United States and Japan. Built in reasonable quantities the American receivers cost anything from £180 to £stg340 according to style, but all use the same 21in colour display tube.

It is likely that when colour comes here we shall use the same colour viewing tube which costs several times more than a 21in black-and-white tube.

At least one British manufacturer has a fully engineered domestic colour receiver of excellent quality ready to go into quantity production. On the basis of selling 100,000 sets in the first two or three years, these receivers will be sold for £stg200 or a little more. There is the hope that the price might be reduced to around £180 after, say, four or five years — if the demand rises significantly.

There is always the possibility of a new colour display tube being developed that could result in a cheaper receiver. Already this year two new colour tubes have been demonstrated by manufacturers in this country.

There is, however, no immediate hope of these two tubes being fully engineered for early production.

If colour were introduced it is likely that programs in colour will be broadcast for just a few hours a week. In America the colour programs vary from two or three hours a week to between 20 and 30 hours a week, depending on the season.

Although in the U.S. there are about 45 million television equipped homes, there are still fewer than 1 million colour sets in regular use after about seven years of colour programming — a slow growth that is a little discouraging to our own potential manufacturers.

Now for my revised forecast. It is that the Pilkington Committee on Radio will decide within six months our future standards and that we will start colour television. And we might have colour in our homes within two years.

"Hardly the time" says L. H. BEDFORD

C.B.E., M.A., M.I.E.E., M.Brit.I.R.E., Past President, British Institution of Radio Engineers.

IT is true that colour television transmission could be started in an extremely short time from the word "go." But whether such transmission would be to the benefit of the viewing public is an open question.

There are three problems which are head-ache material for the authorities.

First, the question of standards. The British standard of 405 lines is unique. All other countries have adopted a higher number of lines.

Judged by practical results, it is doubtful whether the low number of lines in the British standard has any disadvantage, but its uniqueness has. While this matter is under consideration it is hardly the time to introduce a colour service on the present line standards, for nothing could be more calculated to make a change of standards impossible. It is already difficult enough.

(Continued on Page 53)

NEW JAPANESE VIDEO RECORDER

Television picture recording on tape, until recently, seemed to have stabilised on the system developed by Ampex. However, a different approach on the part of workers at the Tokyo Shibaura Electric Company Ltd. has resulted in the appearance of another system, which was described recently in the journal of the Society of Motion Picture and Television Engineers.*

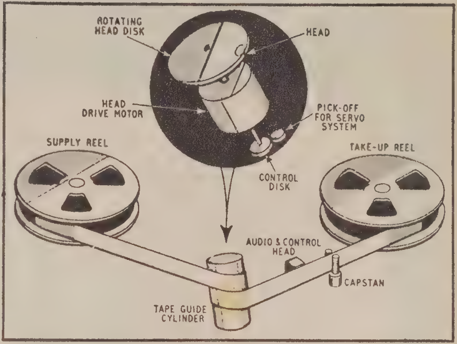

Fig. 1. Simplified diagram of tape-transport and (inset) head arrangements. Tape wraps round cylindrical guide containing rotating head disk so that head crosses between start and finish of spiral where top and bottom edges of tape are adjacent. (Based on diagrams in the original paper.)

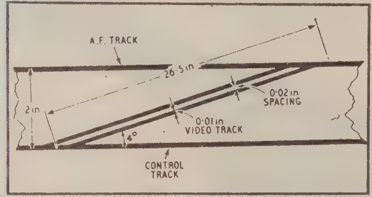

Fig. 2. Layout of tracks on tape. Measurements given are approximate and, for clarity, only two scans of rotating video head are shown. (Based on diagrams in the original paper.)

THE Toshiba system uses only a single head rotating in a cylindrical guide drum round which the tape is wrapped, forming one turn of a helix (Fig. 1). Thus rotation of the head with the tape stationary will result in a track being drawn out by the head, slantwise from one edge of the tape to the other, at an angle of about 4 degrees to the edge of the tape (Fig. 2).

This track is 26.5 inches long by just under one-hundredth of an inch wide and contains one whole field (frame) of the picture starting and finishing in the sync period: the effective tape-speed past the head is consequently about 1/600in/sec. and the head disc speed is 3,600 r.p.m.

To synchronise the sweep of the head with a track on the tape, a position-indicating pulse is produced from the head drive by the passage past a coil of a piece of magnetic material on the spindle. This pulse is "compared" with the field sync pulse and the error signal is used to control the angular position of the head disc which is driven from a supply derived from the sync pulses.

On playback, the field-sync pulses from the head are fed into the phase comparator. Naturally "cleaning-up" of the sync pulses is carried out and this removes noise generated during the short period when the head is crossing the slight gap between the two tape edges. Compressed air is blown through holes in the cylinder to reduce tape wear.

So far, no mention has been made of reel-to-reel, or lateral, tape speed — in fact ,for a still picture it is not necessary to move the tape. As described above, the recorder can record one field and then reproduce it until the tape wears out. The normal tape speed is 15in/sec; but this obviously can be varied to give "slow-" or "fast-motion" effects and, most conveniently, the tape can be kept stationary for editing purposes.

Other important advantages are that, as a "picture" is complete in one track, scalloping of vertical lines cannot occur; head switching is not required, thus there is no danger of switching transients imposing themselves on the picture and the replaying of registered colour signals is made easier.

The sound channel and a control track are recorded directly in the usual way along the edges of the tape with the head gaps at right angles to the tape motion. Now on the tape at these points is a part of the video signal; but, because the heads are not in line with the video tracks and an f.m.-carrier system is used for the picture, no mutual interference is apparent.

The a.f. signal-to-noise ratio on the prototype machine was given as 45dB—in the region of that which one would expect from an ordinary professional machine—and this has since been improved slightly. ("Wireless World.")

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*F.S.M.P.T.E. Vol. 69, No. 12, p. 868. A New Video-Tape Recording System, by Norikazu Sawazaki, Motoi Yagi, Masahiro Iwasaki, Genya Inada and Takuma Tamaoki.

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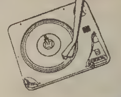

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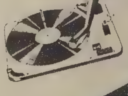

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Special Report on FM-STEREO

After long and careful deliberation, the American Federal Communications Commission recently authorised FM broadcast stations to transmit stereo programs using a compatible multiplex system. Conventional FM tuners will continue to receive what sound like ordinary monophonic programs but specially designed or adapted tuners will provide full stereo output. This special report is reprinted from the August issue of "Radio-Electronics."

By David Lachenbruch

PERPLEXED about multiplex? You're not the only one. Not since the stereo disc was introduced has there been so much confusion in the field of high fidelity.

Many of the answers will unfold gradually. But this much is certain now:

The newly selected FM stereo multiplex standards can provide high-fidelity stereo with a good separation, little distortion and good frequency response from 50 to 15,000 cycles on both channels.

The stereo multiplex standards chosen April 19, 1961, by the Federal Communications Commission, after thorough field testing, were based on similar proposals by Zenith Radio Co. and General Electric.

They provide for a main FM channel that consists of the sum of the left and right stereo channels (L+R), a pilot subcarrier at 19 Kc and a stereophonic subcarrier at 38 Kc (the second harmonic of the pilot).

The stereo subcarrier is amplitude-modulated by the difference of the left and right channels (L—R).

Because the main FM channel carries the sum of left and right, your old monophonic FM receiver will reproduce a conventional monophonic signal through its single amplifier-speaker system.

Stereo receivers contain a matrixing system that combines the difference and sum signal in such a way as to direct the left and right signals to the proper amplifiers and speakers.

The stereo system adopted by the FCC also permits FM stations to transmit a second subcarrier if they wish. This is called a Subsidiary Communications Authorisation (SCA) subcarrier, and is limited to the 53- to 75-Kc range when the station is broadcasting simultaneously in stereo. (The stereo difference subcarrier covers the 20-50-Kc range.)

SCA subcarriers are used for special point-to-point transmissions such as background music for restaurants and factories.

The FCC is allowing stations to transmit both SCA and stereo material at the same time for economic reasons. Some FM stations depend on SCA service for their profits. For many an FM station, SCA service will subsidise stereo broadcasting, which is expected to be unprofitable—at least at the start.

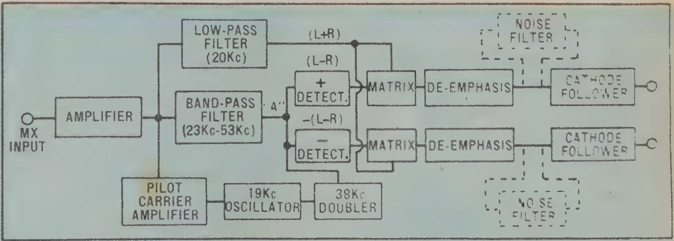
Here are some of the questions most frequently asked about FM stereo, with answers based on the concensus of radio industry opinion at Press time:

How many FM stations will be broadcasting stereo, and how soon?

A few are doing it now. The first to provide stereophonic FM service were WGFM, owned by G-E, in Schenectady, New York, and Zenith's WEFM, Chicago, both started June 1.

The Government permits FM stations

HOW FM-STEREO ADAPTORS WORK



THE block diagram at right shows the sequence of stages in a typical FM-Stereo Adaptor now offered for sale in the U.S.—The Crosby Model MX-101. It is claimed that this unit will operate satisfactorily with a wide variety of existing FM Tuners, provided (1) that the tuner is provided with an output jack from which the composite signal can be derived; and (2) that the signal at this jack be not less than 0.5 volt for full modulation of the carrier.

Operation of the adapter is as follows:

The signal recovered from the multiplex jack of the existing tuner is fed to an amplifier stage, providing about 10db. of gain. The amplified, composite signal from the FM-Stereo broadcast station is then utilised in three distinct ways:

(1) Frequencies below 23,000 cps pass through the upper filter block and constitute the L plus R (left plus right) signal, equivalent to a monophonic version of the original stereo material. This is equivalent, in fact, to what an unmodified FM Tuner would produce from the stereo broadcast but, in the Stereo Adaptor, this L plus R signal is subsequently modified by matrixing.

(2) Frequencies between 23,000 and 53,000 cps divert through the centre filter block. These elements of the composite signal contain the L minus R (or difference between channel) formation, in the form of a suppressed carrier and double sidebands. For example, a 1000 cps L minus R tone would be represented in the composite signal by sidebands at 37,000 and 39,000 cps, the carrier at 38,000 cps having been suppressed.

(3) A weak pilot carrier at 19,000 cps, having an amplitude of only 10pc. of full modulation, is separated by the lower filter block, amplified at 19,000 cps, then used to lock an in-built oscillator. This is frequency doubled to 38,000 cps, mixed with the sidebands and fed to an A.M. detector system. This latter involves two diodes, connected in opposite phase and arranged to produce signals equivalent to L minus R and minus (L minus R).

These respective signals are each added (or matrixed) to a proportion of the original L plus R component obtained via the upper filter block.

The combination of L plus R with L minus R cancels the R component and leaves 2L—in short, the original left channel audio signal.

Similarly, the combination of L plus R with minus (L minus R) produces 2R, the original right channel audio information.

After passing the L and R signals through a conventional 75 microsecond de-emphasis network, the audio signals are available to feed a stereo amplifier channel.

The overall process causes some degradation in the signal-to-noise ratio when the composite signal is used stereophonically, which can pose a problem in weak signal areas or where listeners are disinclined to erect an adequate aerial system. To offer a partial remedy for the situation, Crosby have included "hiss filters" in each channel aimed at striking an acceptable compromise between hiss level and the accompanying loss of extreme treble response.

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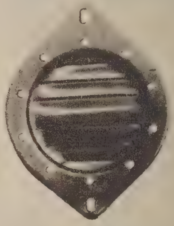

LSH-100, 20 watts

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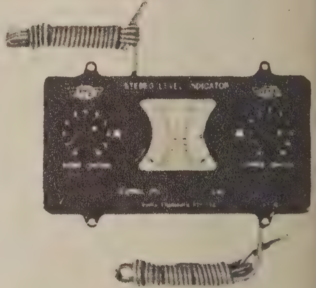

Model ST-B

The General Electric TM2G tone arm (not illustrated) is designed to give optimum performance from mono or stereo cartridges. It features simple weight adjustment, beautiful styling and a superb performance, and is available at the special price of **£17/10/0**

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to start stereocasting any time they wish, if they use FCC-approved transmitting equipment and notify the FCC at least 10 days before they begin.

Nevertheless, probably not more than 20 or 26 stations will actually be broadcasting stereo before the end of the year, because stereo multiplex broadcasting equipment is in short supply.

In most cases, stereo multiplex programming will come to the big cities first. Stereo broadcasting will probably be under way in New York, Chicago, Los Angeles, San Francisco, Philadelphia, Boston and Washington by the time this article appears.

Surveys made by prominent companies or people in the broadcasting industry indicate that only about 40 per cent of the nation's FM stations expect to be stereocasting even by the end of 1962. That would be about 340 out of the approximately 850 FM stations now on the air. Probably some never will convert to stereo.

Will these stations broadcast stereo all day long?

Probably not, at first. While they're breaking in the multiplex equipment and trying to accumulate a backlog of stereo discs and tapes, you can expect just a small amount of stereo programming each day. The expansion will be gradual, as the number of multiplex receivers in the area increases.

When can I get equipment to receive FM stereo?

Some of it is on the market right now. The timetable for stereo receiving gear will run this way: First, adapters for component FM tuners and for tuners in some stereo phonograph consoles will be available. Second, complete stereo tuners for component hi-fi systems. Third, stereo FM-phonograph console combinations. Finally, stereo table-model radios.

What will I have to pay for a stereo adapter for my FM tuner?

Prices of adapters vary widely, from Dynaco's 29.95-dollar kit to H. H. Scott's self-powered adapter at 99.95 dollars. The others are just about everywhere in between. What you will have to pay will depend largely upon the make and model of your FM tuner.

Must my multiplex adapter be made specifically for my tuner, or can any adapter be used with any tuner?

At this early stage, at least, it's recommended that the adapter you buy be specifically designed for your FM tuner. Most tuners made within the last year or two have multiplex jacks; some of them have a "multiplex" or "MX" position on the function control switch.

If yours does have a multiplex jack, there's a good chance it can use an adapter (made by the maker of your tuner) which will work from the tuner's own power supply. But some tuners require self-powered adapters.

There probably never will be a "universal" adapter that will work with every tuner. So it's a good idea to wait until the company that made your FM tuner comes out with a multiplex attachment. At the very least, you should get a guarantee that the adapter you buy will give satisfactory results with your tuner.

Wide-band tuners with ratio detectors are the most easily adapted. Other types can be adapted too, but require more complex adapter circuitry. Some narrow-band tuners probably can't be adapted economically. One less optimistic kit maker warns that "a very high percentage" of existing monophonic FM tuners can't be "satisfactorily" converted. The fact that a tuner includes a multiplex jack is no guarantee that an adapter will work satisfactorily with it.

Is installing an adapter a complicated job?

If you're technical-minded enough to be reading a journal like this, you should have no trouble so long as you use the proper adapter. The simplest adapter just plugs into the multiplex jack of the tuner, and has coaxial output cables for right and left-channel outputs. Others come with complete instructions, some of them including tuner modification parts for optimum performance.

Does multiplex reception require additonal controls?

That depends on whom you ask and whose equipment you buy. Some adapters have no controls at all; they can't even be seen from the control panel, since they're plugged into the back of the chassis. They're generally turned on and off by the "multiplex" switch or function-selector control on the front panel of the tuner. On those that do have controls, the most common knob you'll see will be marked dimension. This increases or decreases the channel separation by varying the relationship of the A+B signal to the A−B signal.

At least one make of adapter (Crosby) also will have a phase control. This is designed to eliminate distortion by adjusting the phase relationship of the subcarrier to the sideband. Other adapters have gain or level controls.

Self-powered adapters have on-off switches. At least two adapters (Fisher and Eico) have pilot lights that glow when a stereo signal is being received.

Will it be possible to adapt monophonic FM tuners in stereo phonograph consoles?

Manufacturers will offer adapters for many recent sets, but some models may require so many modifications that it would be easier to replace the entire FM tuner. Stereo adapter kits for consoles equipped with multiplex jacks will cost between 30 dollars and 60 dollars, depending on make. Most adapters for consoles won't have dimension, phase or gain controls.

Will it be worthwhile to convert table-model FM radios to stereo?

Usually not. In addition to adding a stereo adapter, you'd have to buy a second amplifier and speaker system. In most cases, manufacturers won't offer adapter kits for table radios. History shows that the public is reluctant to "adapt" or "convert."

Will there be table-model stereo radios on the market?

Yes, indeed — but they won't be commonplace until late this year or early next. The first ones will be two-piece "twin" sets joined together by a cable. Actually, the "master" set usually will contain all the active circuitry, and the "slave" will have only the second speaker. Many will be rather expensive. Zenith, for example, expects to price its first stereo table radios at about 140 or 150 dollars.

There will be some inexpensive ones, though. Granco has already announced a line of Stereo Companion radios. They will use the "two-step" approach. The customer can buy a monophonic FM radio first — for as little as 29.95 dollars, including multiplex jack. Later he can buy a Companion unit, with multiplex adapter and twin amplifier and speaker, in a matching cabinet, for 19.95 dollars and up. This is plugged into the master set.

Granco and some others will also sell single-piece stereo table radios. They'll be about 30 inches wide, with speakers mounted at both ends, and with provision for external speakers for greater separation.

Will stereo FM reception pose new problems?

Yes, especially if you live a good distance from the station. Unfortunately, we don't get anything for nothing, and loss of distance is the price of packing extra information into the station's carrier. It's estimated that, on the average, a stereo FM signal will "get out" only about two-thirds as far as a comparable monophonic FM signal, at a given signal-to-noise ratio. For monophonic reception of stereocasts, the station's range won't be cut drastically, but if you want to receive a stereocast in stereo, you can figure that the reach of the station will be cut by about one-third.

Then an outdoor antenna will usually be needed?

It will be more of a necessity than ever. Outdoor antennas are generally recommended for best hi-fi FM monophonic reception — but, with multiplex, antenna installations become critical. Antenna-mounted preamplifiers may be needed in fringe areas to make up for the loss of reach in the station's carrier. They'll be available for as little as 20 dollars.

Doesn't the new stereo system really mean the end of monophonic FM?

Not at all. The radio industry expects to keep on selling monophonic FM table sets, and even hopes for an increased market as a result of the extra attention FM will receive from the new stereo system. Since the multiplex standards are compatible with monophonic reception, signals received on a conventional FM receiver should not be degraded — at least theoretically.

Unfortunately, much of the program material (discs and tapes) now available to FM stations is not 100 per cent compatible — that is, adding the left and right signals doesn't produce a full, balanced monophonic signal. In its report to the FCC on its tests of program material, the National Stereophonic Radio Committee stated that 25 per cent of the stereo discs and tapes now available provide "inferior" monophonic reproduction. The chairman of NSRC's field-test panel, A. Prose Walker went much further, saying only a portion of the available stereo program material is fully compatible. The committee challenged the recording industry to make more stereo records suitable for mono listening when channels are combined.

No one knows all the answers about the new field of stereo multiplexing yet. But for the hi-fi enthusiast, these are the most important facts:

It works. It's good. It opens a new field of stereo enjoyment.

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On odd occasions our clients wonder about the service we offer: the low prices we charge seem to be the cause of their concern.

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We do not claim that an amplifier we sell for £35 gives the same performance as one that we sell for £100.

The complete unit we sell for £92 uses a Nytone 2000 amplifier, a B. & O. pickup with diamond stylus, the Labcraft 605 transcription turntable and Wharfedale 8in or Goodmans Axiette 8in speakers. This is obviously not as good as the £195 unit, which comprises a Sound Sales stereo amplifier (as used by the B.B.C.), the S.M.E. pickup arm, a Thorens TD 124 transcription turntable and two Wharfedale 12in speakers.

It's just like comparing a stock Mercedes sedan and a Grand Prix Mercedes saloon; the units are not the same and cannot possibly sound the same.

Take any price range you wish—*Encel equipment offers you the best value for your money in Australia.* All the world famous brand names are available . . . send for our free stereo brochure today and ask for a quote on any equipment. As we freight equipment to the British Solomons and to Tasmania, **distance makes no difference.** Write today!

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+

Encel Service

=

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SCIENTIFIC & INDUSTRIAL NEWS

PLATING PROCESS

AN electroplating process developed in Hungary, enables porous powdered metal components to be coated with a strongly adherent layer of chromium, nickel or other similar metal. Great economy is achieved, it is stated by leaving out the usual intermediate coating of copper.

The pores in the powdered metal part are sealed with iron oxide, which is obtained by heating the component in an atmosphere of superheated steam. The process has already been used successfully on a wide range of engineering components, it is claimed.

[Altalanes Geptervezo Iroda, 2, Kuny Domonkos Utca, Budapest 5, Hungary]

EXAMINING CRYSTALS

TINY crystals which reflect only a small amount of light from any one surface may be economically and efficiently examined, it is claimed, using newly designed equipment developed in the Netherlands.

As with existing apparatus (known as goniometers) the crystal can be rotated continuously or intermittently in all three dimensions. The contour of its surface can be examined with the aid of light or X-rays.

Even tiny surfaces of the crystal can be located in any given position without readjusting the radiating beam. During an experiment the operator is able to make all readings and observations without leaving his seat.

[Studiengesellschaft Kohle, M.D.H., 2 Kaiser Wilhelm Platz, Mulheim-Ruhr, Germany.]

BOOSTING SOUND

DIRECT amplification of sound waves using microwave radio energy as a power source has been demonstrated for the first time by United States General Electric at its research laboratory.

Amplification of the sound waves, called phonons, is accomplished by "stimulated emission" of energy by atoms as they change from a higher to a lower energy level. This is the same mechanism used in MASER (microwave amplification by stimulated emission of radiation) to amplify electromagnetic radiation. The new phenomenon has been termed the Phonon Maser effect.

According to Dr Guy Suits, the vice-president and director of research, this is the first time that stimulated emission has been successfully used to amplify energy other than electro-magnetic energy. Dr Suits noted that although there is no immediate commercial application of the phenomenon, it provides a significant extension of the principle of stimulated emission, and represents an advance in understanding of solid state physics.

ALUMINIUM v COPPER

A NEW development is going on in electric cables, especially for high-current transmission and distribution. It is is the use of solid aluminium as the conductor surrounded by PVC as insulator.

Copper has become the universal conducting material. But it cannot be extruded in solid rod as easily as aluminium. The aluminium has less than two-thirds the conductivity of copper and less than one-third the density, so that current for current a solid aluminium rod need be only about half the weight of copper. Furthermore, it can be extruded continuously with a somewhat triangular section so that three or four rods, according to the exact shape, can be combined into a circular cable.

[Alcan Industries Limited, Bush House, Aldwych, London, W.C.2, England.]

PURE WATER

PURE water for use in the pharmaceutical chemical and electronic industries can be obtained at a rate of 50 gallons an hour, it is claimed, with the Elgastat E101 de-ioniser.

The unit is housed in a small cabinet with a control panel on the top and has only to be connected to the mains supply to become operational. As soon as it is switched on, water from the mains is passed through a "pre-purifier" which removes most of the dissolved solids.

The water then passes through a cartridge-type de-ioniser which will yield about 1,000 gallons of water before it needs exchanging for a fresh one.

The pre-purifier has also to be recharged at intervals, this depending on the quality of the incoming water. In London, for instance, recharging is necessary after 200 gallons have been drawn, but in Sheffield four times that amount can be handled.

[Elga Products Ltd., Lane End, Buckinghamshire, England.]

VITREOUS ENAMELLING

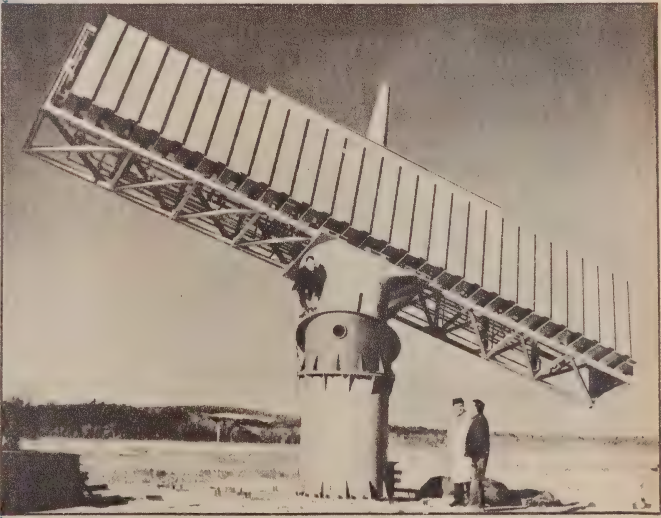
RECENTLY reported in Russian technical literature is an electrostatic method of coating metal articles with vitreous enamel. The coating obtained is said to be of excellent quality and to be especially suitable for baths and kitchen utensils.

Finely powdered enamel is used and this is given an electrical charge as it passes out of the conical nozzle of a spray gun. The particles settle quickly on to the oppositely charged article to provide an even coating which is ready for heat treatment.

Preliminary results indicate that the technique might well be extended to provide ceramic coatings for jet nozzles, turbine blades and various other components where resistance to heat and wear are important factors.

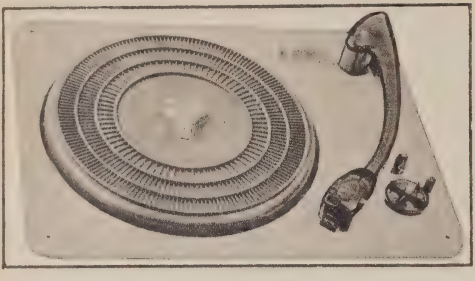
Full technical details given in an article by M. N. Livshits in the Russian

NEW SEA-GOING RADAR ANTENNA



One of the largest sea-going radars ever developed, with a 40ft aluminium antenna and weighing 10 tons, is now undergoing final tests before going into service with the U.S. Navy. Its purpose is to give the earliest possible warning of impending air attack. Developed by the Raytheon company and designed for use aboard cruisers, this equipment, which rotates a full 360 degrees, has 150 horns that beam and collect signals to pin-point attackers hundreds of miles away. It has been specially designed to baffle enemy attempts to jam it.

Hi-Fi STARTS AT THE TURNTABLE



LABCRAFT TYPE 573V

Labcraft

Turntable 573V

- A unique, simple motor suspension and soft, flexible rim-belt drive, which completely isolates all vibration from the baseplate. Rumble less than 0.15 per cent.
- Complete with head, arm, switch, strobomat and built-in governor giving speed adjustment of plus minus 10 per cent on each 4 speeds 16, 33, 45, 78.
- Stylus pressure adjustable 5-10 gm. Featherweight arm-lowering lever.
- Interchangeable heads. Normally supplied with Ronette type 105 t/o stereo cartridge (supersedes type "stereo-OV"). Also suitable monaural.
- User Buyer price inc. Sales Tax with Diamond £23/18/-, with Sapphire, £21/4/6.

THE **ONLY** COMPACT TURNTABLE FOR TRUE **TRANSCRIPTION** PERFORMANCE AT A REASONABLE PRICE

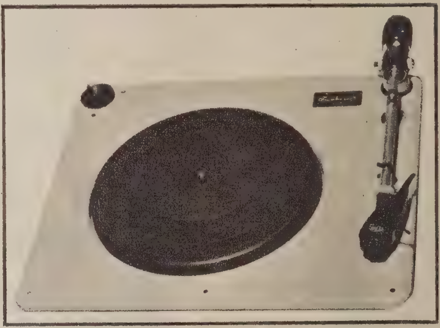
Labcraft

professional type 605

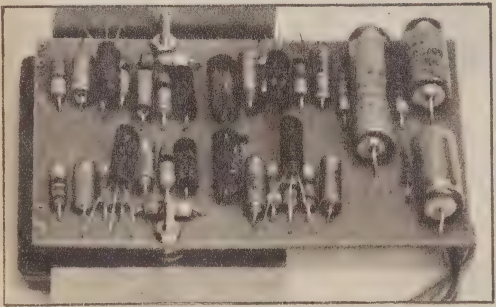
- Fully shielded motor enables use of any low level magnetic pickup.
- Unique motor suspension and rim-belt drive COMPLETELY ELIMINATES RUMBLE, BOTH VERTICAL AND HORIZONTAL COMPONENTS.
- Attractively finished in satin grey and black.
- Available with self-powered transistorized pre-amplifier, boosting magnetic pickup outputs to normal crystal levels—Use your usual amplifier.
- User Buyer price £20/11/6 inc. Sales Tax.

All-Balance pickup arm

- Ball bearings on every turning axis.
- Perfectly counter-balanced with adjustable permanently calibrated stylus pressure.
- All metal arm designed to eliminate resonance.
- Completely eliminates side pressure on your groove-walls. Will track perfectly even with turntable at an angle of 80 degrees.
- Detachable shell which will accommodate any make of high quality cartridge.
- User Buyer price £13/11/6 inc. Sales Tax.



LABCRAFT 605 WITH ALL-BALANCE ARM



LABCRAFT PRE-AMPLIFIER 605B

Labcraft transistorized stereo pre-amplifier

- As reviewed in R. TV & H., August 1961, page 80.
- 2 transistors per channel, fully temperature compensated.
- R.I.A.A. compensation via feedback loop.
- Low harmonic distortion through un-bypassed emitter resistance 2nd harmonic 0.3 per cent, 3rd harmonic 0.1 per cent.
- Input impedance 47 Kohm, matches 'B&O,' 'SHURE,' etc. cartridges.
- Printed circuit construction, extremely compact.
- No hiss. No hum, mounts below 605 turntable chassis.
- Derives "free" power supply from 14V A.C. secondary winding on Labcraft 605 turntable motor.
- User/Buyer price £9/17/- inc. Sales Tax.

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journal Vestnik Mashinostroenia No. 8, Vol. 39, p.p. 67-69.

[The journal and a translation are available on short loan from D.S.I.R. Lending Library Unit, 20 Chester Terrace, London, N.W.1, England.]

PROTECTIVE COATING

TURBINE blades, rocket nozzles and other components used at high temperatures can be given high resistance to oxidation, it is claimed, by means of a coating technique developed by an Austrian concern.

The components, which are frequently made of molybdenum or tungsten, are dipped in a molten silicon-copper alloy. Only the silicon, it is stated, reacts with the basic material, which is coated with a layer of molybdenum silicide and will give protection up to 1,700 degrees C.

Traces of the copper alloy remaining on the surface after the dipping process are removed by a chemical treatment which does not affect the protective layer.

[Metallwerk Plansee A.G., Reutte, Tyrol, Austria.]

LOOK AND LISTEN

BINOCULARS with built-in transistor radios are being made in Japan.

They have centre focusing and are supplied with a small earphone and aerial. The radio is powered by a nine-volt battery and the complete outfit is supplied in a leather case.

[Tokyo Transistor Ind. Co. Ltd., Tokyo, Japan.]

FIRE PROOFING WOOD

VARIOUS products are available for giving fire-retarding properties to wood and among the latest is a Norwegian chemical which includes ammonium phosphates and certain organic compounds. It is said to be particularly suitable for protecting wood and fibre board.

The material is sprayed on to the wood at 400 grammes to the square metre and is then rapidly dried by heating.

When the treated wood is subjected to excessive heat the layer of fire-retarding material foams up and provides a thick non-combustible covering that protects the board from damage.

[A/S Hunton Bruk, Gjovik, Norway.]

TOUGH BEARINGS

BEARINGS which are claimed to be resistant to corrosion and wear and to operate satisfactorily without lubrication even though water or steam may be present have been reported from Canada.

They are made from zirconium metal which is oxidised to produce an ultra-thin layer of blue-black zirconium dioxide on the surface. According to the maker, the secret of success lies in ensuring that the oxidisation process is not carried too far and that zirconium dioxide with the correct crystal structure is obtained.

[Atomic energy of Canada Ltd., 150 Kent Street, Ottawa, Ontario, Canada.]

INSULATION

DEVELOPED by a French organisation is an electrical insulation material said to have remarkably constant properties even when used at high temperatures.

A resin, in the form of a paste, is put in position around the electrical apparatus and then hardened by high-temperature treatment. When used at high temperatures the material loses a small amount of weight and there is a corresponding reduction in volume but, says the company, mechanical and electrical properties remain unaltered.

[Societe Generale de Constructions Electriques et Mecaniques, 32 rue de la Boetie, Paris 8e, France.]

POWERFUL X-RAY

AN X-ray tube said to be 500 times more powerful than conventional tubes can be used to alter the properties of various materials.

It will crack oil, vulcanise rubber and can be used to disinfect medical equipment by irradiation since, says the maker, no living organism could survive the intensity of the X-ray emitted. At the same time fewer precautions are said to be necessary than when using irradiation by isotopes because the tube becomes harmless as soon as the current is switched off.

[A.E.G., AEG-Hochhaus, Frankfurt (Main)-Sud, Germany.]

THE RIGHT ANGLE

AN electronic instrument can be used to determine whether bore holes driven into the ground are located at the correct angles.

The instrument is lowered into the hole and so tilts to the same angle. Moving plates of an electrical condenser in the instruments are displaced from fixed plates by an equal angle and this alters the signal received from the instrument.

Comparison of this frequency with the frequency obtained from a similar instrument on the surface is recorded on a graduated dial which indicates the degree of tilt.

[Hard Metals Ltd., P.O. Box 4587, Johannesburg, South Africa.]

AUTOMATIC SCREWDRIVER

AN automatic screwdriver, designed to speed assembly line methods in high precision work such as the making of cameras, has been developed by a German company.

Screws down to a minimum diameter of 1mm. are placed in bulk into a hopper at the top of the tool. They are then moved singly by a continuous belt into position at the head of the electrically powered screwdriver, which is suspended from above for ease of operation.

Depending on the nature of the work to be done, it is claimed that speeds from four to 50 times those of conventional methods can be achieved.

[A.E.G., AEG-Hochhaus, Frankfurt (Main)-Sud, Germany.]

NEW STEEL PROCESS

A NEW process for making steel is said to yield an exceptionally high thermal efficiency. Although the process is still in the research and development stage, it is claimed that it should produce steel both more cheaply and more efficiently than many processes at present in use.

The operation of the process depends on the use of a specially designed furnace containing a trough-like bed where oxygen will be blown into the metal through a series of "lances." The slag is then tapped off and the steel withdrawn from the other end of the trough.

[Broken Hill Proprietary Co., Essington Lewis House, 500 Bourke Street, Melbourne, Victoria, Australia.]

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NO TRANSFORMER REQUIRED
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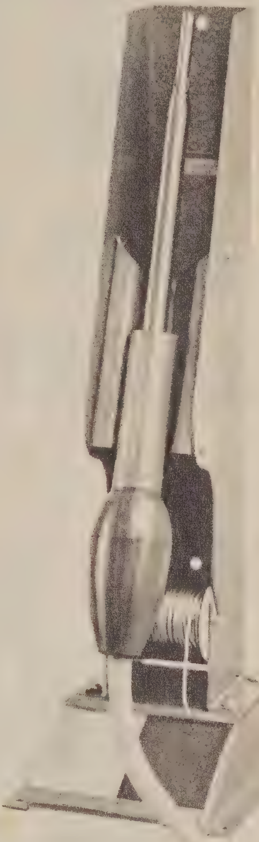
Now made in Australia



***ILLUSTRATED* L64** *3/16" Bit Model operating in Protective Shield* — Complete with accessories—L700
Constant temperature performance for sound and durable joints.
Specialised tools for Radio and Electronics Equipment.
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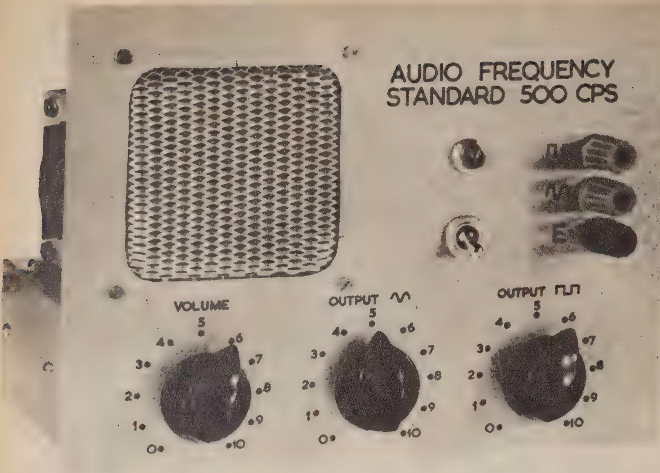


A TUNING FORK FREQUENCY STANDARD

By Keith Jeffcoat

If you have ever felt the need for an accurate audio frequency standard, whether for musical or audio applications, then this article should interest you. It describes a simple, inexpensive, but highly accurate standard constructed around an ordinary musical tuning fork.

THERE are definite practical applications for such an instrument. In th musical field it offers the advantage o an accepted musical standard—the tuning fork — maintained in continuou operation and presenting a high leve output. It should prove invaluable t teachers, piano tuners, and musicians i general, to say nothing of the rapidl growing band of electronic organ builders and similar enthusiasts.

In the laboratory it should prov equally attractive. The fork frequency i easily shifted from a musical standar to a more convenient "electronic" figur and may be used as a standard agains which all other audio gear may be calibrated. Even though only a single frequency is available, it may still be use to calibrate an audio generator at majo points over the entire audio range.

And just how accurate is it? This depends almost entirely on the quality o the fork but, even with the cheapes "music store" fork, it will give a fa higher order of accuracy, cost for cost, than any other scheme. What is more important, it will hold this accuracy indefinitely.

Since the basis of the unit is the aforementioned tuning fork it may be as well, before proceeding to a description of the unit, to outline the history and properties of the tuning fork and the musical standards associated with it.

As early as the first half of the seventeenth century the French priest Mersenne was experimenting with the causes of pitch sensation and the accurate determination of pitch.

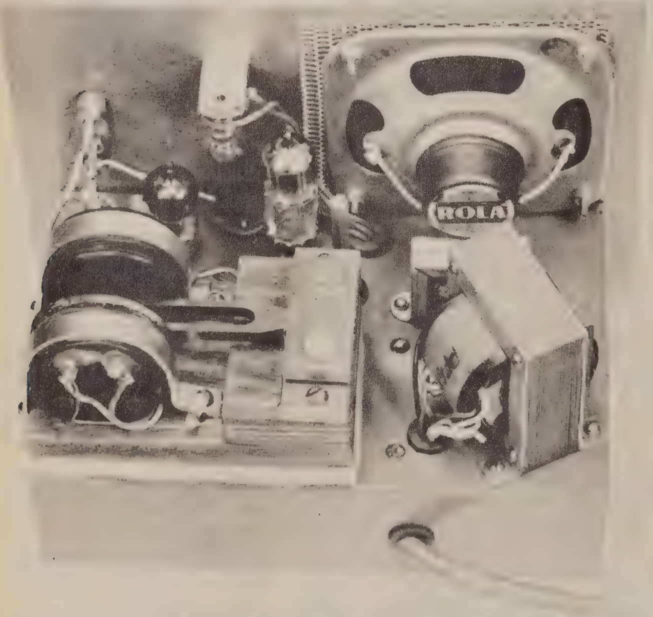
In 1648, he found that the lowest church pitch then in use assigned a value of 373.7 cps. to the A and that the secular, or chamber, pitch A was 402.9—roughly equal to pitches between F and G and G and A flat below the present standard A.

In the time of Bach, pitch standards were undergoing a transition, for improved French woodwinds were being made to lower pitches than had been used in making German organs.

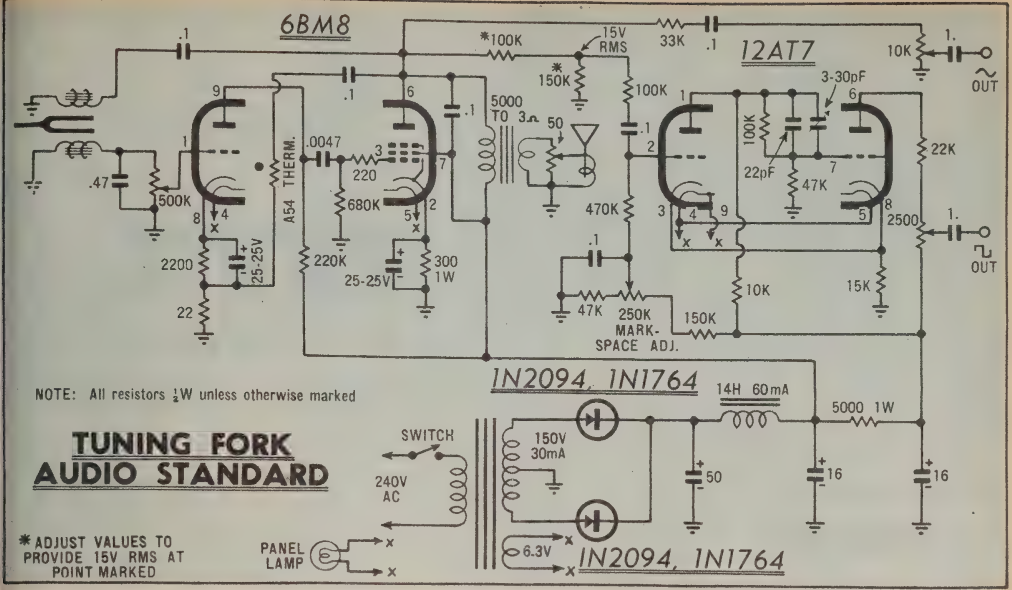
As a result, the instrumental parts to a good many of Bach's church works show a built-in correction for the discrepancy, with the organ and string parts (the former by necessity, the latter by habit) scored in a key lower than the wind parts.

Since organs of the period were not ordinarily built to equal temperament, the need to compose in practicable keys complicated both Bach's problem and the problem of figuring out, ex post facto, just what pitch value he had in mind for which compositions.

The pitch problem is easier with Handel, who, though born in the same year as Bach, spent most of his creative life in England and left to posterity a tuning fork he had used during those years.



The photograph above and that at the head of the page show the front and rear views of the instrument. The odd angle at which the power transformer is mounted prevents hum being induced into the pickup coil



Here is the main circuit diagram of our audio standard. The Schmitt trigger square-wave generator is optional and may be disregarded where the instrument is to be used for musical purposes only. Ample gain to maintain the fork in oscillation is provided by the single 6BM8.

This fork, which gave off an A of 422 cps.-plus, was invented in the year 1711 by John Shore, Handel's famous trumpeter. Since it is known that Mozart's piano was tuned to an A of 421.6 cps., the usual assumption is that composers in the eighteenth century thought of their music as being performed at an A value of between 415 and 430 cps.

With the nineteenth century, pitch began to rise. In 1813 the London Philharmonic was using an official A of 423.7 cps. Then it bounced up to 452.5, relented to 433 in 1826, and zoomed up again to 455 within the next 20 years. In the U.S., concert pitch reached even higher—461.6 cps.

The main reason behind this tendency to push pitches up seems to have been the urge to produce more "brilliant" sound.

Many attempts have been made to bring about some kind of unanimity about pitch and to eliminate troublesome excesses.

The first formal action was taken by a group of physicists who met in Stuttgart in 1884 and adopted, surprisingly enough, an A of 440 cps., the same as we use today.

However, nobody paid much attention to it and, in 1889, an orchestral standard A of 434 cps. was adopted, backed by the famous Diapason Normal tuning bar, which, although cherished in a vault at the Conservatoire, turned out to have an actual vibration rate of 435.45. So much for the infallibility of standards.

In May, 1939, an international conference was held in London and it was agreed to recommend to all interested organisations the adoption of a 440 cps. A. The recommendation was given a mixed reception but in the U.S.—aside from conductors' sneaking it up a little now and then—the 440 A is pretty generally recognised.

At a second conference in London in 1954 the International Standards Organisation once again agreed to a uniform pitch based on a vibration rate of 440 cps. for the A on the treble staff above middle C.

This is the standard which is accepted today and it will be found that all musical type tuning forks conform to this standard. In point of fact the two most commonly available forks are the A 440 and the C above middle C, which is 523.3 cps.

In order to assist musical organisations in maintaining consistent pitch, the U.S. Bureau of Standards broadcasts a 440 cps. signal from Washington (W.W.V.) and some orchestras do use this standard to tune to, in lieu of the oboe which was formerly used.

From the foregoing it may be con-

PARTS LIST

1	R, TV & H. standard small instrument case and chassis.
1	12AT7 Valve.
1	6BM8 Valve.
2	Silicon Diodes (1N2094, 1N1764, etc.).
1	Power transformer 150/150 volts 30mA, 6.3v, 1.8A.
1	Choke—14 H, 60mA.
1	Thermistor type A54.
2	Low impedance earphones (see text).
1	Tuning fork.
1	Toggle switch (240 volt type).
1	Pilot light and bezel.
1	4in loudspeaker.
1	Output transformer—5,000/3 ohms.
2	9 pin valve sockets.

CAPACITORS

1	50mfd—300 volt.
2	25mfd—25 volt.
2	16mfd—300 volt.
2	1.0mfd—125 volt.
1	.47mfd—100 volt.
6	.1mfd—200 volt.
1	.0047mfd—200 volt.
1	22pF—Ceramic.
1	3-30pF Trimmer.

RESISTORS

All ½ Watt unless specified

1	22 ohm
1	220 ohm
1	300 ohm 1 watt
1	2,200 ohm
1	5K, 1 watt.
1	10K
1	15K
1	22K
1	33K
2	47K
3	100K
2	150K
1	220K
1	470K
1	680K
1	50 ohm Potentiometer
1	2,500 ohm Potentiometer.
1	10K Potentiometer.
1	250K Potentiometer.
1	500K Potentiometer.
2	8 lug tagstrips.
1	2 lug tagstrip.
3	Terminals—2 red and 1 black.

3 core flex, 3 pin plug, 3 instrument knobs, nuts, bolts, hookup wire, etc.

Hardware For Fork Assembly.

1	Piece of brass stock — ¼in x ⅞in x 5in long.
2	Plywood blocks—½in x 4½in x 3in and ½in x 1¾in x 3in.
1	Piece of foam plastic 4½in x 3in.
2	Machine screws ½in x ¼in Whit. Hex. head.
6	Wood screws.
2	Aluminium straps ⅜in x 5½in.

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- **WORKSHOPS**
- **LABORATORIES**

The Ferris Model PS19 Power Supply is a compact, portable mains operated unit offering low voltage with low ripple content for current demands of up to 5 amps. It is extremely stable under varying load conditions.

SPECIFICATION

INPUT VOLTAGE
200, 240, 260,
50 C.P.S.

1. VOLTMETER RANGE
0 to 20 V.D.C.

3. AMMETER RANGES
0 to 0.1a, 0 to 1a, 0 to 5a.

DIMENSIONS
8in x 7in x 6in.

RECTIFIER
Full Wave Bridge

OUTPUT VOLTAGE
Two ranges:
4.5 to 10 at 5 amps.
10 to 20 at 2.5 amps.

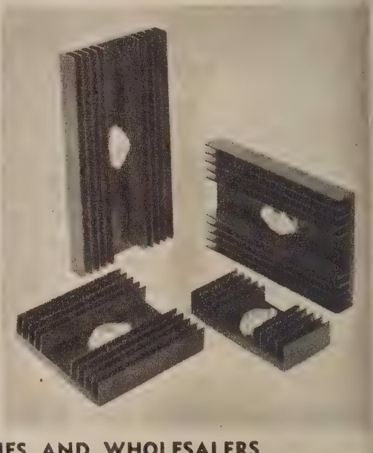
RIPPLE
30 mv for 12 watts dissipation.

WEIGHT
18lb.

The output, which is continuously variable through two selected voltage ranges, is monitored by a separate voltmeter and ammeter. A spring loaded range switch is incorporated in the ammeter circuit so that the meter always returns to the highest range, thus giving it protection against accidental overload. In addition, the instrument is fuse protected against overload.

OTHER POWER UNITS AVAILABLE ON APPLICATION

HEAT SINKS FOR POWER TRANSISTORS



Heavy gauge extruded aluminium section, finned and black anodised for maximum heat dissipation efficiency. Available in the following sizes and ratings. Mounting holes suit standard power transistors.

SPECIFICATION (Conditions: .0015" Mica Washer—D.C.4 Silicone Grease)

TYPE No.	Heat Sink Dimensions	Approximate Total Area	Max. Collector Junction Temp.	Ambient Temperature	Max. Collector Dissipation
7000	4in x 2in x .75in Ditto	50 sq. ins. Ditto	90 deg. C Ditto	30 deg. C 60 deg. C	11w 5w
7001	4in x 4in x .75in	100 sq. ins.	90 deg. C	60 deg. C	7w
7002	4in x 6in x .75in	150 sq. ins.	90 deg. C	60 deg. C	9w
7003	4in x 8in x .75in	200 sq. ins.	90 deg. C	60 deg. C	11w

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cluded that there are good reasons for the existence of a tone standard and common agreement on what frequency the standard should be. Now let us look at the fork itself, the physical form of which, incidentally, has remained unchanged since originally invented by Shore in 1711.

Basically a tuning fork consists of a handle, or "stem" as it is more correctly known as, and two forks or "tines." When a fork is struck and held in the air the two tines move away from and towards each other at a frequency determined largely by their cross sectional area and length.

In addition to this "fundamental" frequency there are also a number of overtones present, the frequencies of which are governed by other modes of vibration in the fork. These overtones are inharmonic and bear no relationship to each other or to the fundamental.

MUSICAL STANDARD

The most prominent of these is a high partial tone (usually two octaves and a major sixth above the fundamental) the sound of which is quite weak and fades rapidly, particularly when the stem of the fork is placed against some form of sounding board.

For use as a musical standard the tuning fork has the advantages that its pitch is hardly affected by changes in temperature, that for all practical purposes, it retains its pitch permanently, that it is of convenient size, and that its pitch can be adjusted in case of need by careful filing. It is this latter feature which is of particular advantage to us when we want to use the fork on a frequency other than the standard tones available.

For use in early acoustics laboratories, a tuning fork was often fitted with a resonance box. In shape this was rather like a large matchbox with one end removed. It carried a knob with a hole in it, into which the stem of the fork could be fitted. The resonance box had its own note, just as a glass jar has (as we discover by blowing across the top of it) and this note was deliberately made different from the fundamental note of the fork. If the two were resonant at the same frequency the box would respond too much and soon drain away the energy of the fork.

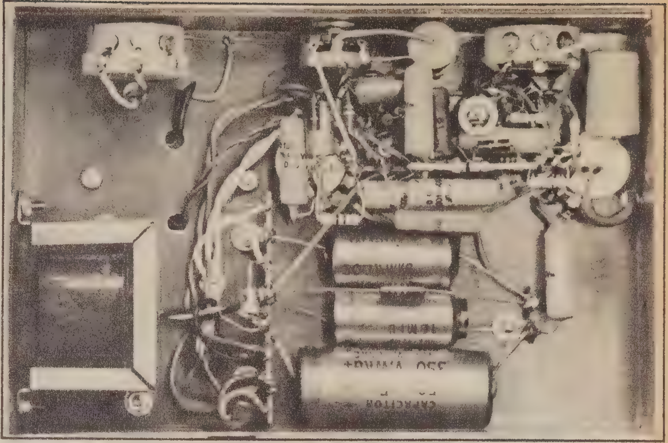
PURE TONE

Though these resonance boxes were an excellent source of a practically pure tone of known frequency, their major disadvantage lay in the finite duration of the tone for each time the fork was struck.

One way of overcoming this is to use the fork as the frequency determining element in an electronic oscillator. In point of fact this is just what we have done. Our fork forms a highly selective feedback mechanism placed between the input and output circuits of a simple two-stage amplifier.

(This subject of Audio Standards was also covered in the October and November, 1958 issues of the magazine and readers desirous of pursuing the matter further, including the various other ways of obtaining standard frequencies, would do well to refer to those issues.)

The construction of our particular unit commenced with the purchase of a tuning fork. Inquiries around the local music houses revealed that while there were a number of different brands of tuning forks available varying in price from 10/ to around 17/, there were only two frequencies commonly available, the standard A (440 cps.) and the C above middle C (523.3 cps.).



The underchassis view above shows the layout of the minor components. While space is at a premium around the two valve sockets, the actual construction is not as difficult as may be imagined from this photograph. Most components in this section are terminated on the 8-lug tagstrip mounted between the two fixed controls.

One firm did offer a set of 12 forks covering a full chromatic octave, but these would have to be specially imported with a waiting time of approximately two months. Incidentally the cost of this set, about £13, is very reasonable considering the high standard of accuracy to which they are constructed.

For the greatest order of accuracy over a varying range of temperatures a special tuning fork made from an alloy called "Invar" is used. This material, which is roughly 36 per cent nickel and 64 per cent iron, has a very low coefficient of thermal expansion and is also used for such things as clock pendulums, measuring tapes and measuring instruments. Forks made from this material are not easily available and have to be imported from overseas to special order.

Since we wanted to make sure that our standard could be easily duplicated we steered clear of the "special" types and purchased a standard "C" unit at a cost of around 10/. The choice of the C fork in preference to the A was made for the following reason:

The frequency of a tuning fork can be altered by filing either the tips of the tines, to increase frequency, or the V between the tines to decrease frequency. The disadvantage of the former is that extreme care is necessary to preserve the same length in each of the tines, otherwise the fork will lose activity and may not oscillate.

With the latter method no such extreme care is necessary and, accordingly, since we required a frequency of 500 cps., we decided to reduce the frequency of the C fork (523.3 cps.) instead of increasing the frequency of the A fork (440 cps.).

DISPOSALS HEADPHONES

Having decided on our fork, the next step was to obtain the two coils between which the unit was to vibrate. Since each of these coils must be wound on some form of permanent magnet the logical choice was a pair of headphone units with the diaphrams removed. Ideally, in order to provide maximum gain, high impedance units should be used, but large quantities of low impedance units are available from disposals sources at very reasonable prices. In the interests of economy it was decided to try these units first.

The ones we used carried the code letters "C.L.R." and were made in at least two brands, S.T.C. and Stromberg-Carlson. It was found that a single 6BM8 would provide adequate feedback

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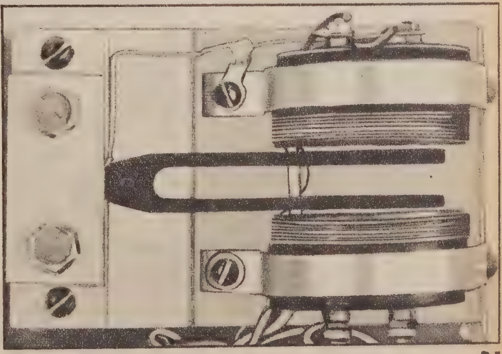

Here is the fork unit viewed directly from above. Note the lead which forms a common ground connection between the input earphone metalwork and the fork clamp.

ANOTHER FERGUSON FIRST

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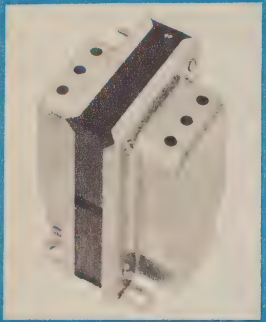

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		VOLTS	VOLTS	mA	
PVD100	250 TAP 240 " 230	120 TAP 110 " 100	310 OR 285 " 260	80	6.3V-3A C.T.
PVD101	250 TAP 240 " 230	145 TAP 135 " 125	380 OR 355 " 330	80	6.3V-4A C.T.
PVD102	250 TAP 240 " 230	120 TAP 110 " 100	310 OR 285 " 260	100	6.3V-4A C.T.
PVD103	250 TAP 240 " 230	150 TAP 140 " 130	380 OR 355 " 330	100	6.3V-5A C.T.
PVD104	250 TAP 240 " 230	120 TAP 110 " 100	310 OR 285 " 260	125	6.3V-3A C.T. 6-3V-3A
PVD105	250 TAP 240 " 230	126 TAP 136 " 146	380 OR 355 " 330	125	6.3V-3A CT. 6.3V-3A
PVD106	250 TAP 240 " 230	172 TAP 162 " 152	450 OR 425 " 400	125	6.3V-3A C.T. 6.3V-3A
PVD111	250 TAP 240 " 230	124 TAP 114 " 104	310 OR 285 " 260	150	6.3V-3A C.T. 6.3V-3A C.T.
PVD107	250 TAP 240 " 230	146 TAP 136 " 126	380 OR 335 " 330	150	6.3V-3A C.T. 6.3V-3A
PVD108	250 TAP 240 " 230	173 TAP 163 " 153	450 OR 425 " 400	150	6.3V-3A C.T. 6.3V-3A
PVD109	250 TAP 240 " 230	146 TAP 136 " 126	380 OR 355 " 330	180	6.3V-3A C.T. 6.3V-4A
PVD110	250 TAP 240 " 230	193 TAP 183 " 173	500 OR 475 " 450	200	6.3V-3A C.T. 6.3V-4A.

*Voltages are for 2 x 100 MFD using OA210 or IN1763 diodes.

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in conjunction with these units and accordingly these were adopted in the final design.

Coming now to the actual circuit of the instrument we can see that the headphone coil used to pick up the vibration from the fork is fed to the grid of the triode section of the 6BM8 via a 500K potentiometer. This control is necessary to prevent overloading of the grid by the rather large signal generated by the fork when it is vibrating. The .47mfd capacitor across the coil tunes it close to resonance at 500 cps. and improves the output waveform and amplitude.

A 220K resistor forms the plate load of the triode and output is fed from this plate to the grid of the pentode section via a .0047mfd coupling capacitor and a 220 ohm resistor, the latter to prevent parasitic oscillations. The .0047mfd capacitor was chosen to attenuate bass response in the unit.

A small speaker transformer forms the plate load of the pentode and couples the audio tone output to the loudspeaker via a 50 ohm speaker volume control. The .1mfd capacitor across the primary of this transformer attenuates the treble response and minimises any possibility of self-oscillation within the unit. The .1 capacitor coupling the plate of the pentode to the driving coil completes the oscillatory circuit.

A.G.C. SYSTEM

The only other major circuit feature is the A.G.C. system. In order that vibration of the fork should commence and build up to the desired amplitude within a reasonable period of time, the amplifier needs to have a fairly high gain when first switched on. If left unchecked, however, this build up soon rises to the point where the tines of the fork rattle against the pole pieces of the earphone and the whole system becomes overloaded.

This problem is fundamental to all such oscillators, and calls for some form of automatic gain control. One of the most successful schemes we have used in the past is a conventional negative feedback system with the addition of a thermistor to vary the feedback according to the output. In this circuit feedback is taken from the plate of the output pentode to the cathode of the input triode, with the thermistor in series with the feedback line.

The rest of the circuit comprises a simple full-wave power supply, using silicon diodes, and a 12AT7 valve wired as a Schmitt trigger to provide square wave output for amplifier testing etc. No explanation of the square wave circuit will be given as this was fully covered in the article on a "Wide Band Audio Oscillator" in the May, 1960 issue.

Where the instrument is required only as a musical standard the square wave generator and the two output attenuator networks can be omitted, leaving only the 6BM8 feedback oscillator. The four-inch loudspeaker mounted on the front panel will provide adequate output level for the tuning of musical instruments.

The rear view photograph of the instrument shows the layout adopted. The rather unusual angle at which the transformer is placed was chosen to minimise hum pick-up by the input coil on the fork unit.

As it is possible that the field from individual transformers may vary slightly it will be best if, during the construction of the unit, this transformer is held in place by only a single nut and bolt. After completion of the wiring it may be orientated for minimum transfer of hum to the pickup coil and then firmly bolted in position.

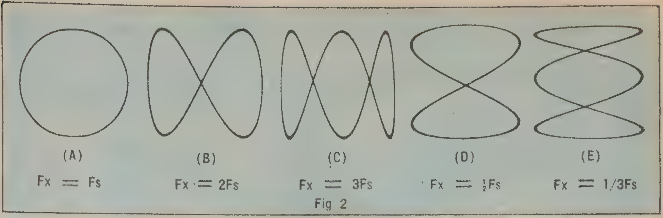

Fig 2

The diagram above shows some typical Lissajous patterns. Note that, if either the unknown or standard frequency is not a perfect sine wave, the shape may be slightly different, though the general form will remain the same.

The fork unit, complete with its driving and pickup coils, is mounted as a sub-assembly on a small wooden block. This is glued to a piece of foam plastic which is glued to the main chassis. The method is necessary to prevent mechanical feedback between the fork and the loudspeaker.

A detailed drawing of the parts making up the fork mounting is included and it is unnecessary to discuss this at length except to emphasise that the mounting must be perfectly rigid. If there is any movement of the fork in the holder its activity may be so reduced that it will not oscillate but, even if it does, the reliability of the instrument may be seriously impaired.

BRASS MOUNTING

In our case we used two pieces of ¼in-thick brass with a channel filed between them to accommodate the stem of the fork. The pieces are held together with two ¼in Whitworth brass bolts, the bottom piece being drilled and tapped to take these bolts. One of the advantages of this system is the ease with which the fork may be removed when adjustments to its frequency are being made.

When assembling this unit the fork should first be secured firmly in position and then the earphones placed so that the ends of their magnets are approximately 1/16in from the tines of the fork. Our experiments showed this to be the optimum distance. Too close a spacing tends to increase harmonic content rather severely, or may even allow the tines to strike the magnets. Too great a spacing may make oscillation difficult to maintain.

The under-chassis view shows the layout adopted. The filter choke is mounted on the chassis sidewall at the far left and alongside it is an 8-lug tagstrip used to mount the two silicon rectifiers, the 240-volt lead termination and the three filter capacitors.

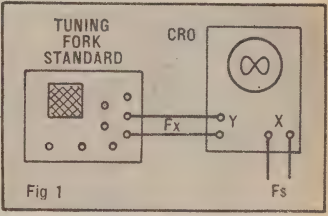

Fig 1

Illustrated above is the method of unit inter-connection used to produce the Lissajous figures, which show the relationship of a known to an unknown frequency.

Most of the components associated with the 6BM8 and the 12AT7 are terminated on an 8-lug tagstrip mounted between the 500K input potentiometer on the feedback oscillator and the 250K potentiometer used to adjust the mark-space ratio of the square-wave generator. The three potentiometers brought through to the front panel are from left to right; speaker volume control, sine wave output attenuator and square wave output attenuator.

INITIAL TEST

After completion of the wiring and checking for mistakes, particularly around the HT circuit, all gain controls should be advanced to their maximum position, and the unit switched on. If the two earphone coils are phased correctly the fork should commence to vibrate within about one minute and an audio tone will be heard. Should no output be heard the connections to one of the earphones may need to be reversed to provide the correct phasing.

Vibration of the fork will be started by the normal room noises and, with the amplifier set to maximum gain, should soon rise to the point where there

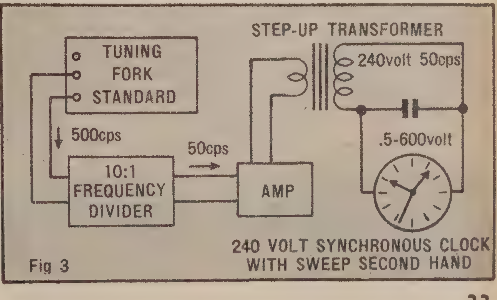

Fig 3

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This diagram shows the method of interconnecting the various units in order to check the frequency of the fork by means of a synchronous clock motor. The time base of your CRO can be used as the 10 to 1 frequency divider.

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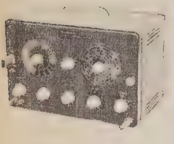

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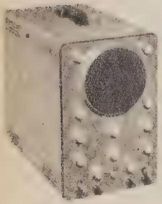

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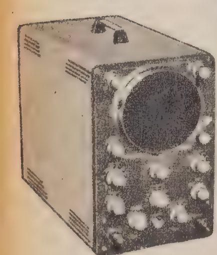

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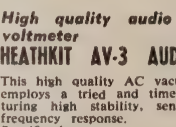

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Range: Volts — 0.01, 0.03, 0.1, 0.3, 1, 3, 10, 30, 100, 300 volts, RMS, full scale.

Decibels: Total range — 52 db to plus 52 db. Scale —12 to plus 2 db. Ten switch-selected ranges from —40 to plus 50 db.

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is severe overloading of the amplifier stages and attendant harmonic distortion. Connect a CRO to the sine wave output terminal and adjust the gain control for the minimum setting which will ensure reliable starting of the oscillator, consistent with a good output waveform.

If the instrument is required purely as a musical standard, there is little more that need be done. There will certainly be no problem of frequency calibration, since the frequency is determined almost completely by the fork itself. If it is assumed that the fork is an accurate musical standard in the first place, no further adjustments should be necessary.

CONVENIENT FIGURES

However, if it should be required as an audio standard, the "odd" frequencies of the musical range are hardly suitable and will need to be changed to a convenient "round figure." As mentioned earlier, a C fork is most easily shifted to 500 cps., in which case the fundamental and multiples will coincide with major calibration marks of audio generators, etc.

Calibrating the fork against a known frequency can be most conveniently done by the use of a cathode ray oscilloscope and the Lissajous method of comparison. The major advantage of this method, for our purpose, is that a fundamental frequency relationship is not required. An integral relationship must exist between the standard and the unknown frequency, but one may be a harmonic or subharmonic of the other.

Figure 1 shows how an unknown frequency (fx) and a standard frequency (fs) may be applied to an oscilloscope having its internal sweep oscillator switched off. The unknown is applied to the vertical amplifier input; the standard to the horizontal amplifier input.

When the frequencies have an integral relationship, either even or odd, the pattern will be stationary on the screen. Figure 2 shows typical patterns.

When the fundamental of the standard and unknown frequency are equal, a circle or ellipse (Figure 2A) is obtained. When the unknown is a harmonic of the standard (as in B and C), a series of connected horizontally aligned loops is obtained. The unknown frequency then is determined by multiplying the standard frequency by the number of loops.

When instead, the unknown is lower than the standard frequency a series of connected, vertically aligned loops (such as C and D) are obtained. The unknown frequency then is determined by dividing the standard frequency by the number of loops.

NUMBER OF LOOPS

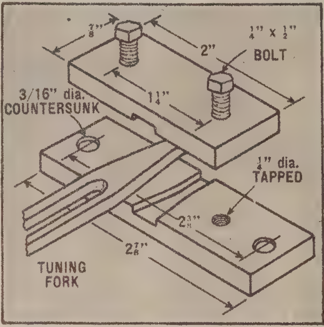
This method is limited only by the number of loops which can be counted on a screen of given size. It may be employed with ease, with a 5-inch screen, for frequency ratios up to 10 to 1, and with some difficulty at higher ratios.

Before making any frequency adjustments to the fork we must first have some fairly accurate standard with which to compare it, and probably the most convenient and easily available of such standards is the 50 cycles of the 240 volt mains.

Reliable sources inform us that, averaged over any half-hour period, the frequency of the mains will be exactly 50 cycles. More important, the maximum deviation (encountered only in peak periods perhaps once or twice a day) is only one-tenth of a cycle (or .2 per cent) in either direction.

(Note that these figures apply only to areas which are within the "grid system" of N.S.W. and Victoria. Other States and some country areas may not be so good.)

When using the mains as a calibrating standard it is important that the effect of any individual fork adjustment should be carefully checked over at least a 5 or 10 minute period. If the fork is very close to frequency the Lissajous pattern will be observed to drift slowly in one direction, remain stationary for perhaps 5 seconds, and then drift slowly in the other direction. This "drift" is caused by the mains "hunting" back and forth over the 50 cycles mark as it equalises for variation in loads.



Here is an exploded view of the tuning fork mounting. Other methods may be used to mount the fork, so long as there is no compromise with the prime requirement of rigidity.

If a greater order of accuracy than this is required, it will be necessary to find some suitable standard against which it can be compared. Generally, these are not very readily available, but an exception is the standard time signals available on radio or phone. These may be used by arranging for the fork to drive an electric clock, and we used this latter method on our own unit. We will have more to say about this in a moment.

Reducing the frequency of the fork is achieved by carefully filing, with a round file, in the V of the fork between the tines. Using this method there is little danger of the fork's activity being affected, but the process should be undertaken in a slow and methodical manner with regular pauses to check the frequency. Otherwise there is a danger of filing right past the desired figure.

If this should happen it will be necessary to file the tips of the tines in order to raise the frequency again, and here a great deal of care has to be exercised. If the tines are filed to unequal lengths the activity of the fork may be so reduced that it will no longer oscillate satisfactorily and further grinding, which may take us too far in the other direction, will be necessary.

Once having obtained the necessary 10 to 1 Lissajous pattern and checked it over at least a half-hour period, we can be reasonably sure that the fork is within half a cycle of 500 cycles. In most cases this order of accuracy will be all that is required but, if something better is needed, the electric clock and time

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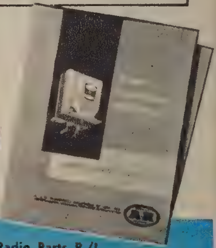

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standard method, mentioned earlier, may be used.

Figure 3 is a block diagram of this. The 500 cps. from the fork is passed through a 10:1 frequency divider, the output of which will be 50 cps. This output is amplified and passed through a step-up transformer (240 to 6 volt filament transformer reversed) and applied to a 240 volt electric clock having a sweep second hand.

One method of achieving the necessary 10 to 1 frequency division would be to use a twin triode in a 50 cps. multivibrator circuit, using the 500 cps. from the fork to lock the multivibrator. However, there is another method which is quite satisfactory for a test such as this, and which uses the C.R.O. time base. Since this should be available anyway, it probably will be more convenient.

10-TO-1 DIVISION

The 500 cps. from the standard is fed into the vertical amplifier of the C.R.O. and the time base adjusted so that 10 complete cycles are visible and securely locked on the screen. The output of the time base (which must now be running at 50 cycles) is amplified and used to run the clock. The fact that the time base has a sawtooth waveform is of little consequence, but will be partly corrected by the .5 capacitor placed across the secondary of the driving transformer.

Most clocks require about two watts of power, will usually operate from any voltage between 200 and 250, and are not voltage conscious. Allowing for losses in transformers etc., it would be wise to use an amplifier having a nominal power rating of around four watts at least, more if available.

By setting the clock to coincide with a known time standard (say the "pips" on the radio or the P.M.G. time service on B074) and noting any change between the two over a given period of time, it is possible to determine the frequency of the fork with extreme accuracy.

Say, for instance, that our clock was found to be one second slow at the end of one hour. Since there are 3,600 seconds in one hour our standard must be one part slow in 3,600, or approximately 0.14 cycle low in frequency. By extending the time over which this check is made it is entirely possible to check to a greater accuracy if desired.

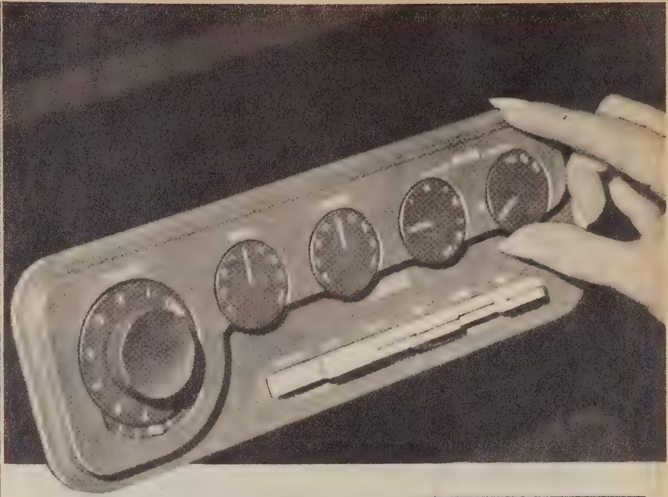
CARE NEEDED

At this stage it should be noted that simply rubbing the tines of the fork once across a sheet of medium glass-paper will raise the frequency by approximately one-tenth of a cycle. Hasten slowly!

The limit of accuracy would seem to be set by the fork itself, since there is little point in trying to achieve a standard which the fork cannot maintain, due to temperature changes, etc. In our case a figure of one second per hour was easily achieved, with the prospect that this could be bettered if sufficient time was available to make and check small changes in the fork.

The final step is to adjust the square wave generator for optimum waveform shape. In order to provide sufficient range of adjustment for the mark-space potentiometer the trigger circuit needs an input signal with an amplitude of approximately 15 volts R.M.S. and this is set by means of the simple divider

(Continued on Page 111)



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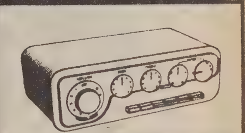

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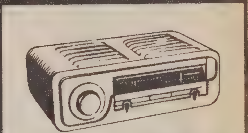

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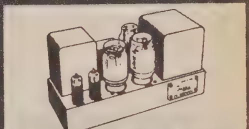

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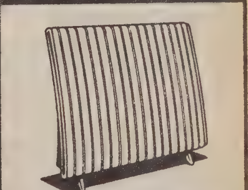

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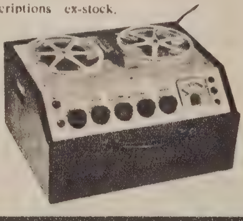

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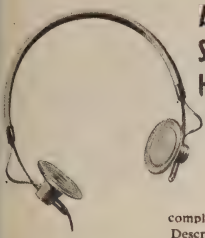

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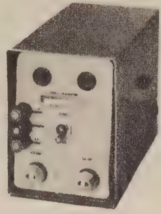

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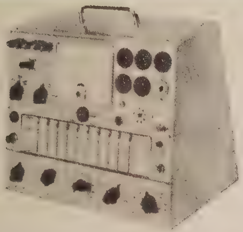

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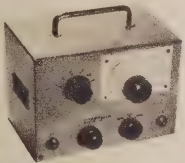

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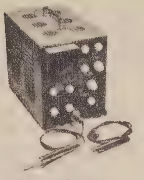

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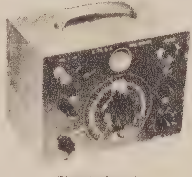

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Here's your answer, Tom!

Last month in these columns we discussed the operation of the junction diode and of transistors. Following on this month, we discuss the various tests which may be applied to transistors and show the basic requirements for a practical testing instrument.

By JAMIESON ROWE

WE saw last month that, at normal temperatures, thermal wandering of minority carriers across the collector-base junction of a transistor takes place and is described by Icbo, the "leakage current." This effectively places the base at a slight forward bias with respect to the emitter, with the result that the normal amplification action produces an emitter-collector current. This current, effectively an amplified version of Icbo, is called Iceo or I(co').

If a transistor is functioning correctly, the leakage currents are quite low. Icbo is in the order of microamps, and Iceo in the order of tens (or perhaps hundreds) of microamps.

ABNORMAL CURRENTS

If the transistor is damaged, however, the leakage currents will be abnormal. For instance, if partial or complete fusion or punch-through of the collector-base junction has occurred, both leakages will be abnormally high. An open circuit due to current surges can also occur, and would show itself in the form of tiny or non-existent leakage currents.

In short, the leakage test gives a good idea of the condition of a transistor. It is thus a desirable "first test" to perform on an unknown unit. Figure 1 gives the two basic leakage tests which may be performed on PNP transistors (for NPN types the battery and meter polarities are reversed).

In (a) we have the test for the amplified leakage current Iceo. With the base lead disconnected, a potential is applied to the transistor such that normal conditions effectively prevail (collector-base junction reverse biased, base-emitter junction forward biased). A meter is inserted to measure the current flowing.

Figure 1 (b) gives the alternative leakage test, this time for Icbo. This is similar to the previous case except that only the collector-base leakage is measured. This will be smaller than Iceo by a factor equal to the value of Beta (the small signal common-emitter current gain, which will be discussed below) at the small current level involved.

Either Icbo or Iceo, compared with manufacturer's data, will serve as an indication of the condition of the transistor, as they are both manifestations of the same effect. Thus in practice it becomes largely a matter of choice as to the test performed. Some designers tend to favour the measurement of Iceo, since it is larger and requires less sensitive meters for accurate measurement.

Now for the measurement of current gain. As we saw last month, the transistor is basically a current amplifier. A small change in base current is accompanied by a large change in collector current.

According to the way in which the transistor is connected into the surrounding circuit, this gain is considered in two main ways. If the emitter is used as the element common to both input and output circuits (common emitter configuration or operation), the gain is described in terms of Beta. If on the other hand the base is used as the common element (common base configuration), the gain is described in terms of Alpha.

Thus Beta is called "the small signal common emitter current amplification ratio," and is defined as the ratio of a change in collector current Ic to the change in base current Ib producing it (with the collector voltage held constant with respect to the emitter). Beta is thus a simple number, ranging from 10 to about 500.

Alpha is defined as the ratio of the change in collector current Ic to the change in emitter current Ie accompanying it (with the collector-base voltage constant). Since emitter current equals collector current plus base current, Alpha is always less than unity (one). Alpha is described as "the small signal common base current amplification factor."

Since Alpha and Beta are merely different manifestations of the same physical effect within the transistor, one may be expressed in terms of the other. In fact, Beta is equal to Alpha divided by (one minus Alpha). This is shown in Figure 2, where the two main gain testing methods are shown for PNP types. For NPN types, battery and meter polarities are reversed as before.

For the measurement of Beta (shown in diagram a), meters are inserted in the base and collector leads. By means of R the base current is altered by a certain amount, and the corresponding change in collector current noted. The ratio of the two current changes thus gives Beta at the operating point concerned.

Figure 2(b) shows the equivalent circuit for the determination of Alpha. Here the collector and emitter currents are metered, while the base current merely enables them to be varied. The ratio of collector current change to emitter current change gives the value of Alpha.

Fairly obviously, the values of Beta and Alpha given by this type of test are rather rough. The values obtained are effectively a mean of those at both operating points, rather than the values at either point. Since the current amplification changes considerably over the working range of currents and conditions, this introduces error. However, the value which is obtained is usually sufficiently accurate for most purposes.

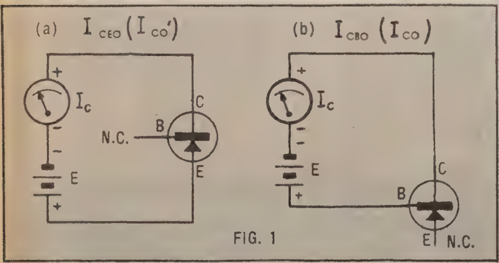

FIG. 1

$$\beta = \alpha' = \frac{\Delta I_c}{\Delta I_B} \qquad \left(\beta = \frac{\alpha}{1-\alpha}\right) \qquad \alpha = \frac{\Delta I_c}{\Delta I_E}\ (<1)$$

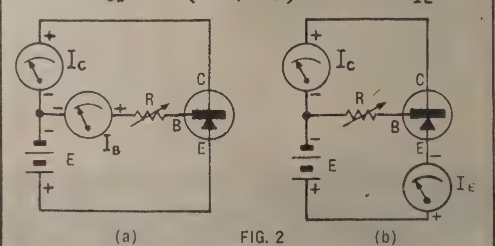

FIG. 2

More refined tests use static DC conditions on the transistor but impress an AC component to the base (or emitter, as the case may be) and measure the AC collector current component. If the amplitude of the AC signals is kept low, the values of Beta and Alpha obtained are quite accurate for the DC operating point concerned.

Reverting back to our simple gain testing circuits, however, we see that they can be modified to provide useful values of Beta and Alpha in an easier fashion and with less testing equipment. Figure 3 shows the modified form of the Beta testing circuit of Fig. 2(a).

Since with many practical transistors the base current is very small, the series base resistor for testing becomes quite large. Thus the base current supply becomes effectively a constant current source, virtually independent of the small base-emittter junction resistance of the transistor. The series resistor may thus be fixed in value for all transistors, and thus the base current is fixed at a suitable value.

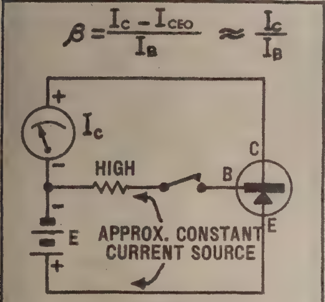
$\beta = \frac{I_C - I_{CEO}}{I_B} \approx \frac{I_C}{I_B}$
I_C
HIGH
C
B
E
E
APPROX. CONSTANT CURRENT SOURCE

FIG. 3

Testing procedure with the simple circuit is now very quick; firstly a reading is taken with the base supply switch open, i.e., measuring Iceo. Then the base supply switch is closed, placing a known input current on the base. The new collector current Ic is measured, and Beta found as (Ic minus Iceo) divided by Ib. For a convenient approximation, Beta may be taken as equal to 1c over Ib (assuming Iceo to be quite small compared with Ic, which it usually is with practical transistors).

The remaining test which is often applied to transistors is that which determines the breakdown voltage of the collector-base junction. This junction, which is normally reverse biased in operation, has a voltage at which zener or avalanche breakdown occurs.

If this voltage is known, the circuitry around the transistor may be arranged to safeguard the transistor against damage. In addition transistors may be selected for high voltage applications.

Figure 4 shows one way of determining the breakdown voltage. The transistor is connected via a high resistance R to a source of about 100 VDC. The fairly high voltage source places the transistor on the breakdown part of its curve, while the resistance R prevents damaging current from flowing. The transistor voltage is measured with a high-resistance voltmeter, which reads the actual breakdown voltage.

The curves shown in Fig. 4 show how the applied voltage and load resistance place the transistor effectively "just into" the breakdown region. R must be chosen so that its value is low enough to place all transistors in their breakdown region, but large enough to prevent damage to any transistor. A compromise is usually made, or various values of R used for groups of transistors having similar breakdown voltage and dissipation.

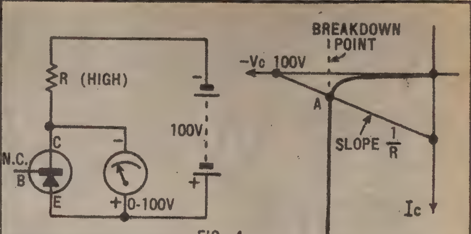

FIG. 4

These then are the tests which are most commonly applied to transistors. A practical instrument will usually have facilities for applying both the leakage and gain tests to a transistor, with one test circuit and meter being switched for each function. The test for breakdown voltage may or may not be provided, according to the application intended and the price.

That completes our discussion of transistor testing, Tom, and it also draws to a close our series on measuring instruments. Next month we will revert to our original question-and-answer style, and start attacking the back-log of readers' questions.

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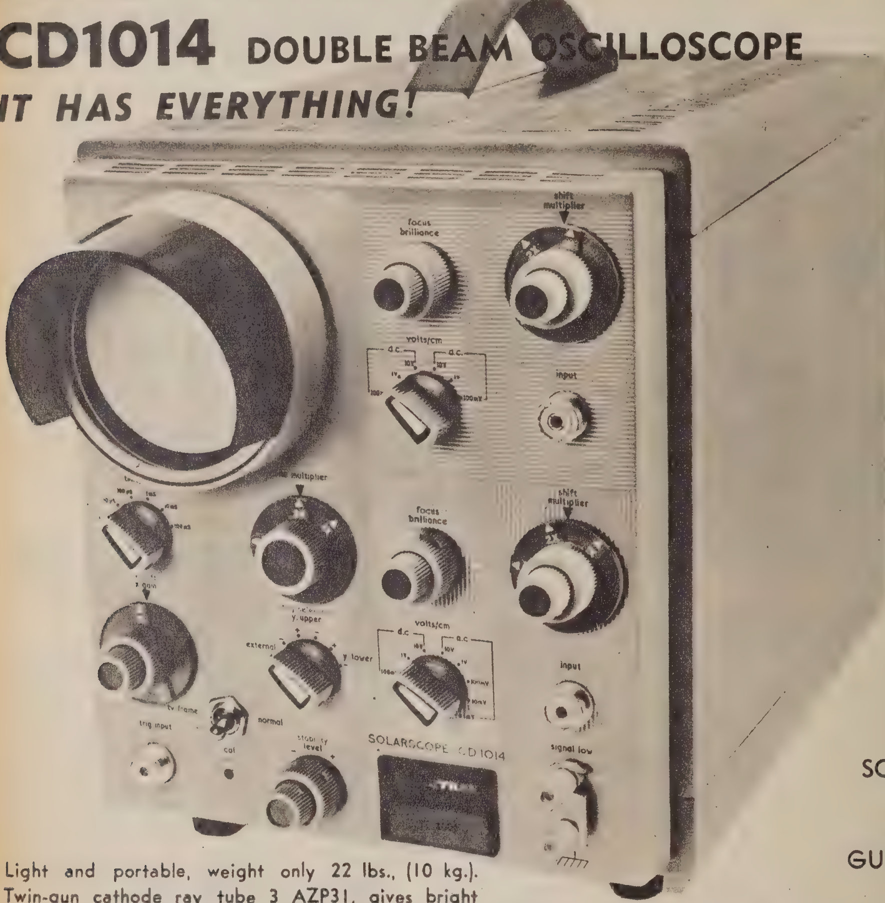
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FROM THE SERVICEMAN WHO TELLS

THE CASE OF THE FAULTY MIXER

Although TV and radio receivers constitute the bread-and-butter lines in the average service shop, there is usually a variety of less conventional items, ranging from burglar alarms to schoolboys' crystal sets. And fairly prominent in this minority group will be PA amplifiers. Almost every communal organisation owns an amplifier in some form, and servicing them can be a profitable sideline if conducted properly.

THIS story concerns just such a unit. It was, in fact, the heart of a fairly elaborate PA system installed in one of the local churches. As well as providing straightout voice reinforcement during services, it was used for a wide variety of more complex jobs during social gatherings, meetings, lectures, etc., and those concerned were quite proud of its versatility and the skill they had acquired in using it.

THE CUSTOMER

It was brought to me by one of the church members who, while not highly technical, makes himself responsible for minor repairs, or seeing to it that more complex ones are passed over to the likes of yours truly.

He listed three complaints in all; two minor ones of fairly long standing and one major one, recently developed, which was really responsible for my services being sought. Prior to that, the two minor faults had not been of sufficient consequence to justify the unit being taken out of service.

The amplifier was a fairly elaborate affair, though typical of such installations. With a pair of 6L6s in the output it was obviously capable of delivering a healthy signal, while the front end had provision for mixing a pair of microphone inputs and a pair of pickup inputs. All in all, a very versatile unit.

The pickup mixing circuit was the main cause of the bother, one channel having suddenly turned cranky and refused to turn off. I gathered that this had caused some embarrassment, since it chose to happen in the middle of a program. The producer had planned for the introduction of soft music at a crucial point, whereas the operator, placing what he imagined was a dead pickup on the record in anticipation, brought forth music that was both too loud and too soon.

CHANNEL "OUT"

For the rest of the program fancy fades, etc., were out, at least as far as that channel was concerned. In fact, it was difficult to make use of it at all, since the volume control appeared to have very little effect. This, then, was the main reason why the amplifier had been brought to me. I imagined the cause would be simple enough, but I could sympathise with those who had been caught.

Of the other two faults, one concerned a microphone channel. According to the customer it appeared to have more gain than its opposite number and, more important, the gain control was very abrupt in its action. This latter effect had also caused some embarrassment. Inadvertent excessive gain settings for the channel had caused uncomfortably loud—if brief—outbursts of sound and feedback.

Finally there was what had come to be known as "that noise." This was a weak but audible crackling-cum-rustling sound which appeared from time to time, stayed long enough to be annoying, then vanished just as positively. I didn't blame them for not wanting to tackle that themselves—I wasn't too keen to tackle it either.

But there was no point in meeting trouble halfway. All I could do was start on the obvious troubles and hope that the noise would show up at some time when I could get to grips with it. I decided to tackle the faulty pickup channel first.

MIXING SYSTEM

The mixing system was a fairly conventional arrangement, consisting of four .5 meg. potentiometers—two for the pickups, two for the microphones—all connected to the grid of the main amplifier stage through similar value isolating resistors. Those for the pickups operated directly from the pickup terminals, and those for the microphones from their respective pre-amplifier stages.

A few quick checks on the offending pickup channel confirmed the customer's complaint; the control was exerting only a nominal influence on the level, which seemed close to "flat out" most of the time. Small wonder that the operator was embarrassed.

But it turned out to be a delightfully simple fault. An ohmmeter check on the relevant pot. showed that it had no connection whatever to chassis, and a more detailed examination of the pot. itself showed why.

The pot. was of a type in which the element is mounted on the inside of the moulded body, forming a cylinder which is concentric with the shaft. (This is in contrast with the type in which the element lies flat in a plane at right angles to the shaft.) Each end of the element is clamped under a metal strip which is really the end of the external connecting lug. In addition, there is a spot of glue covering both ends of the elements where they almost meet, and cementing them to the bakelite case.

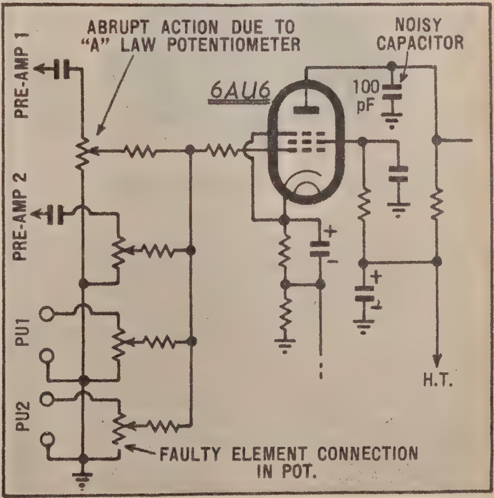
LOOSE ELEMENT

It was at this point that the trouble had occurred. The spot of glue had broken and the earthy end of the element had moved towards the rear cover and away from the metal clamp-cum-contact near its front edge. It had probably been a gradual process, and had now reached the stage where the electrical contact had finally failed.

I have taken the trouble to describe this component defect because, of all the faults I have encountered in pots. over the years, this is something of a rarity. Unfortunately I have no way of knowing whether it was a manufacturing defect or as the result of abuse in fitting or servicing.

Anyway, it was simple enough to fit a new one, and fault number one was crossed off the list.

Next I attacked the abrupt control in the microphone channel. I had noticed, while working on the previous problem, that the pot. used in this particular channel was a "foreigner," in that it was of different make from all the others. While not by any means conclusive, I felt the fact was sufficiently significant to justify further investigation.


ABRUPT ACTION DUE TO "A" LAW POTENTIOMETER
NOISY CAPACITOR
PRE-AMP 1
6AU6
100 pF
PRE-AMP 2
PU1
PU2
H.T.
FAULTY ELEMENT CONNECTION IN POT.

Three faults which occurred in a typical P.A. amplifier. Two involved potentiometers used in the mixing circuit, the third was an intermittent noise caused by a rare component failure. In combination, they imposed serious limitations on the use of the amplifier.

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The mounting of the pot. was such that I was unable to read the maker's specifications immediately, but slackening off the retaining nut and giving things a half turn brought it into view. wasn't really surprised when I read; 0.5 Meg/A," the "A" being the designation for the "law" of the element. More specifically, it indicated that it was linear," rather than the more conventional "log" type.

It was now fairly clear what had happened. At some time in the distant past this particular channel had required a new pot., possibly in a hurry. Someone, either through ignorance or because it was all that was available, had fitted the linear pot. If they thought about it at all they probably reasoned that any pot. was better than none, at least on an emergency basis.

GOOD INTENTIONS

It is even likely that they fully intended to replace it with the correct type at the first opportunity. Unfortunately, I am told, the road to the nether world is paved with good intentions. Still, they probably meant well.

Anyway, whatever its history, it was the obvious cause of both the abrupt action and the fact that this channel appeared to have more gain than its neighbour. In fact, of course, both channels were virtually identical, the undue crowding at the "off" end of the pot. merely giving the impression of more gain.

Once again, the cure was simple. A new pot., with the correct law, was all that was needed to restore a smooth action and, apparently, balance the gain.

Finally, there was "that noise." So far had been unlucky, the brief periods of operation revealing no sign of the trouble. All I could do was leave the set in operation until it showed, and hope that it would remain in evidence long enough to be of some use. So I cleared a corner of the bench, set things up, and waited.

It must have been my lucky day. Hardly had I settled down to the next job when the PA speaker gave a faint but definite crackling sound which quickly settled down to something rather more definite.

WHERE IT WASN'T

My first action was to quickly turn all controls — previously well up — back to zero. If it was in any of the early stages, this should pinpoint it fairly closely. As it turned out, I wasn't that lucky, for the noise still continued. But at least I now knew where it wasn't, and, believe me, that can be extremely important in cases like this.

The main amplifier consisted of a twin triode in a long-tailed pair arrangement, driving the output valves, this in turn being fed from a 6AU6 immediately following the mixing network already described. Seizing a screwdriver, I shorted out the input grid to the long tailed pair, and this immediately stopped the noise.

Well, I was getting closer. I crossed my fingers and hoped that it would hold on for just a few more minutes. Since was obviously somewhere in the 6AU6 circuit I then shorted that grid to chassis, but this had absolutely no effect. So it was somewhere between the two grids.

Was it the 6AU6? Probably, and I pulled it from its socket to make sure. But it wasn't, for the noise persisted. This narrowed the area to the plate circuit components, of which there were only two, the plate load resistor and a 100 pf mica by-pass.

Mainly because it was easiest, I lifted the 100 pf capacitor clear first. The noise stopped. I put it back and the noise started. I tried another 100 pf and there was no noise. I put the original one back and the noise re-appeared. So that was it. As far as I was concerned it was a noisy 100 pf mica capacitor; a rather rare fault, because these components seldom give much trouble.

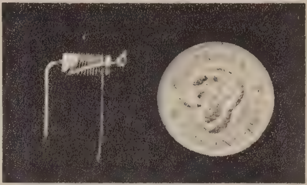
Because of its rarity, I happened to mention the fault to a colleague a few days later, and he immediately showed more than usual interest.

"Was it," he asked, "one of those little brown fellows, about so, by so, by so . . .?" (accurately describing the one in question.)

"Why, yes," I replied, "why do you ask?"

"Handled thousands of the things during the war. They were normally quite reliable, but wartime conditions probably created problems. Anyway, they used to suffer a partial breakdown, even in quite low voltage circuits, and caused faults exactly like the one you just described. Nearly drove us mad in some

NEW DEVICE PUZZLES READER



IN a recent query a reader relates how, while examining the underside of a late model TV chassis, he encountered a strange-looking gadget which he cannot identify. He describes it as ". . . looking like a small carbon resistor with a coil of light gauge tinned copper wire wound over it. Electrically, this coil appears to be in series with the resistor, but I am puzzled as to its purpose and the fact that the wire in the coil does not appear to be insulated."

Well, I'd say that is a fair description of the contrivance pictured above, a very ingenious little overload protection device developed in Australia by Pye Industries Ltd., and named by them the "Circuit Sentry."

In general, the reader's description is correct. It does consist of a small resistor, value about 22 ohms, overwound with a bare wire coil. However, the wire is not tinned copper, but high tensile steel, and its function is basically mechanical, rather than electrical.

Note how one end is bent sideways, under considerable tension, and soldered to one of the resistor pigtails. The other end forms a pair with the remaining resistor pigtail.

In use, the device is connected in any circuit where overload protection is required, say the HT line to the horizontal deflection system. The value of the resistor is so chosen that, under normal operating conditions, it will run moderately warm.

However, should an overload occur, the resistor temperature rises, the blob of solder melts, and the spring steel wire flicks away from the resistor pigtail. The broken circuit effectively protects valuable components which might otherwise be permanently damaged.

Although intended to do much the same job as a fuse, Pye engineers claim that it has a number of advantages over the latter. For one reason or another fuses can cause a lot of bother, one of the most common faults being simply loose contacts, giving rise to intermittent or complete set failure.

Another is that they are surge sensitive. To be effective, fuses must be rated so near the normal working current, that they often blow when there is no real danger, due to short duration surges. This may be further aggravated by fuse "fatigue," or the fact that fuses deteriorate with prolonged use.

RESULT IS A NUISANCE CALL

In either case the result is a nuisance call; a service call costing considerable time and money to replace a fuse which should never have blown.

Another point is that fuses are often replaced or repaired by set owners themselves, without any real regard to rating. Anything does so long as the set can be made to play in time for a particular program, often with disastrous results to expensive components.

The "Circuit Sentry" has been designed to overcome these faults. It is soldered into the circuit, so cannot suffer from contact troubles. It has sufficient thermal delay to ignore normal surges, yet responds rapidly in the event of a prolonged overload. And it can be mounted under the chassis, away from tampering fingers, since it should need attention only in the event of a real fault.

As fitted to Pye receivers, this device will be found in the HT line supplying the horizontal deflection components. Pye engineers claim that this is where the great majority of expensive component failures occur, often due to abuse on the part of the user.

It frequently happens that picture circuits fail in the middle of an exciting story. Having followed the plot thus far, the viewer is naturally anxious to know how everything works out and, if the sound is still working, will invariably leave the set running.

Unfortunately, what was a minor fault often builds up to a major one as expensive components slowly disintegrate under gross overload conditions. Only when the bill comes in does the owner realise just how expensive was that last half hour of the picture!

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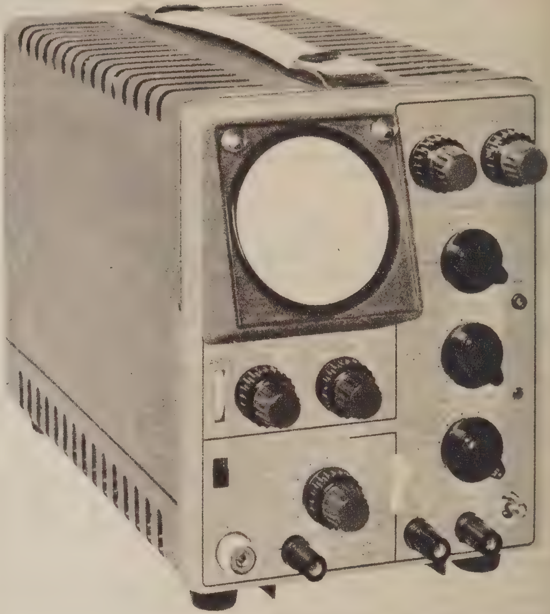

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of the complex services equipment. My bet is you struck one left over from those batches."

And the more I think about it, the more I imagine he may be right. The amplifier, while still modern in the broad sense, was several years old and probably had been constructed as a labour of love by some well-meaning church member. Even if all parts had been brand new, it could easily be that some left-over stock of mica capacitors was still in circulation at the time. The offending unit could easily have been purchased and used in all good faith.

So, if you strike an odd noisy mica capacitor from time to time, don't be surprised. There could still be an odd one or two hanging around.

WHY DOES IT HAPPEN

My only other comment on this job concerns the incorrect type of pot. used for the microphone control. We all know that a linear pot. will give this undesirable effect, but have you ever stopped to ponder why? Probably not, but if you are interested I will do my best to explain.

It might be easiest to grasp the idea if we first consider a conventional volume control circuit as normally used to feed the grid of a valve. This is simply a variable voltage divider and, provided no current is drawn from the tapping—as is usually the case—the voltage division will be exactly equal to the resistance division. Thus, if we know the voltage applied to the total resistance, it is easy to calculate the voltage available at any value of tapping.

Suppose, for example, that the pot. has a typical value of 1 megohm and that we apply it to a signal of exactly 1 volt. If we now set the tapping at .5 meg. (from the earthy end) it will deliver exactly .5 volt to the following grid. Again, at .25 meg. it will deliver .25 volt, at .125 meg., .125 volt, and so on.

Next we should consider what happens to the signal level, in decibels, when we make specific changes in resistance setting. (Since decibels portray mathematically what our ears observe acoustically, they are the logical units to use.) The easiest wasy to do this is to take as our reference point the "full on" condition of the control, call this "0 db," and give all lower levels a negative value relative to it.

TYPICAL STEPS

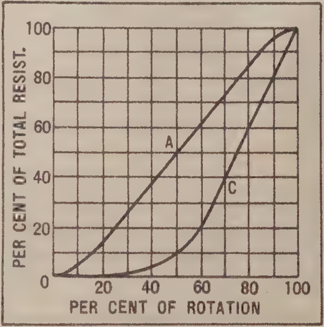
Further, let us select 6 db as the value of the steps we wish to observe. There is nothing magical about this value, except that it represents a worthwhile change acoustically, and is also equal to a voltage change of two to one, a nice round figure.

Our first step, therefore, say —6 db, will call for a two-to-one change of resistance (from 1 meg. down to .5 meg.) or, in a linear pot., a movement equal to half the total movement.

Our second step, from —6 db to —12 db, will call for another two-to-one resistance change, or a decrease from .5 meg. to .25 meg., represented this time by a known movement equal to a quarter of the total. To produce our next step, from —12 to —18 db, we go from .25 to .125 meg., or a movement equal to only one-eighth of the total.

See what's happening? As we move towards the zero end of our linear pot. the amount of movement required, for a given change, becomes progressively smaller. Whereas the first 6 db needed half the available movement, this has been reduced to a mere 1/16 by the fourth step. Since it will continue to decrease at the same rate it rapidly becomes too small to be practical, and we say that the action is "critical" or "crowded."

It was to avoid this condition that engineers developed the "tapered" or "log" pot., these being general terms rather loosely applied to almost any law that is not linear. In fact, there are about eight different laws available from most manufacturers, some of which are intended for rather specialised applications.



Graph showing the "A" and "C" laws used by potentiometer manufacturers. The "A," or linear, law causes crowding at the low level end; the "C" law is even over entire range.

Of them all the "C" law is probably the most popular. This comes close to the ideal as might be assessed from our previous discussion, i.e., equal amounts of rotation now produce equal changes of resistance ratio. More specifically, for example, we find that a movement roughly equal to 1/10 of the total will now give us our two-to-one resistance change (6 db) over most of the range.

The result is something with which we all are familiar. Regardless of where, in its arc, the knob needs to be set, the control it exerts on the level remains the same for a given movement. Perhaps we take such things pretty much for granted, but it is worth remembering that it didn't just happen that way; someone had to sit down and work it all out in the first place.

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The MULLARD CORDLESS MANTEL RECEIVER

By Philip Watson

A current trend in radio receiver design is towards the "cordless set"; a transistorised version of the popular four valve mantel set so well estabished over the years. There is no doubt that a completely self-contained domestic receiver represents just about the ultimate in convenience, and many predict that this type will become just as popular as its predecessor.

AT one time we used battery receivers only by necessity, never by choice. The bulk, running cost and general inconvenience of valve types were such that they would never be used while ever one was within reach of the power mains.

Not so today. Transistor type sets are so economical that, in spite of the high cost of power bought in batteries, they can be considered as serious rivals to valve-operated mains sets. While, initially, the transistor breakthrough was directed mainly at making smaller and better portables, the economy of these sets quickly attracted the more domesticated listener.

Perhaps he had little use for a portable as such, but it was a mighty handy gadget when he wanted to hear a program while pottering around the garden, while lounging on the veranda, or in fact, anywhere in the home where there was no power point.

And so was born the idea of a domestic, battery-operated receiver. Not a portable, because a portable may have disadvantages in this application, but a battery receiver specifically designed for domestic use.

Unlike a portable, it may use a cabinet of — relatively — quite generous proportions, as well as being styled to blend with the furniture, rather than to withstand the rigours of teenagers on the beach. Not only will the larger cabinet contribute a measure of acoustic efficiency, it will also allow the use of a much larger speaker, still further improving overall efficiency and audio quality.

Conversely, sensitivity may be less important in such a set, as it is unlikely to be used in unfavourable localities.

Equally important (many people contend) it will look so unlike a portable that there will be no temptation for the teenagers of the family to "borrow" it every time they plan a day on the beach or in the bush!

All of which adds up to the fact that such a set needs to be designed as such, not merely adapted from portable techniques. There are many possible approaches to the problem, but one currently in the news comes from Mullard Australia Pty. Ltd., as published in the company's technical publication, "Outlook" for May-June, 1961.

A significant feature of this design is the fact that it has been possible to achieve a suitably high order of performance using only five transistors and two diodes, a significant reduction on the line-up normally specified for typical por tables. This is due partly to the steadil improving standard of transistor generally, and partly to the careful tailo ing of the design to do a specific job.

As originally presented by Mullar the data includes the circuit, all coil an transformer winding specifications, pe formance figures, plus a printed wirin board design for those who prefer th form of construction. In short, everythin needed to enable any well-equippe laboratory to turn out a near duplicat of the circuit and put it into quanti production.

However, such physical details as th size and style of cabinet, size and type speaker, type of dial, and the assembly all these in the most efficient manner, a decisions left to the individual man facturer.

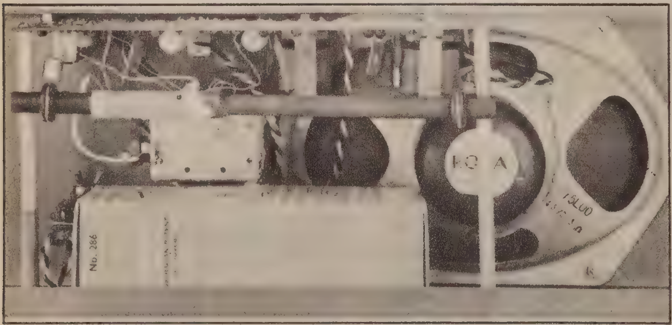
OUR SUGGESTIONS

For this reason home builders, well as those sections of the trade inte ested in supplying them, have suggeste that we might give them a lead in th regard. The results are portrayed on the pages. If you want to build the Mulla Cordless Receiver, this is how we su gest you could go about it.

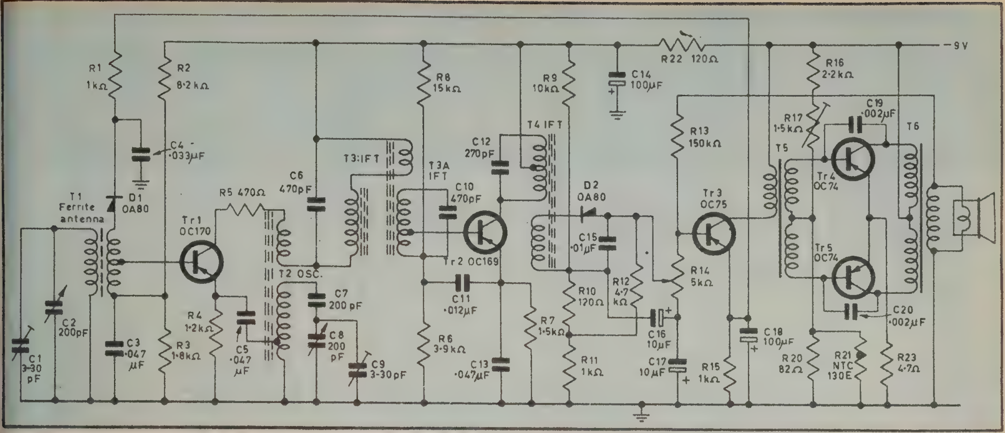
However, before discussing this aspe in detail, a summary of the ci cuit features and performance figures, published by Mullard, will help put th readers into the picture who did not s the original article.

The receiver uses the new alloy di fused junction transistors, types OC17 and OC169, as oscillator-mixer and I amplifier respectively, in a straight-fo ward sedign without netralising compo ents. Effective automatic gain control achieved by damping the antenna circu without shifting the operating point the IF amplifier.

The audio frequency stages consi of an OC75 Class A driver followed 2-OC74 output transistors in Class push-pull. The maximum undistort power output is 500 mW. Sensitivity 140uV/m for 50 mW output, or approx



Rear view of the complete assembiy. If a planetary drive is used in front of the gang, a cut-out should be provided in the rear lip to facilitate battery replacement. Note the generous speaker dimensions.


-9V
R1 1kΩ
R2 8·2kΩ
C4 ·033μF
T1 Ferrite antenna
D1 OA80
C1 3-30 pF
C2 200pF
C3 ·047 μF
R3 1·8kΩ
R5 470Ω
Tr1 OC170
R4 1·2kΩ
C5 ·047 μF
C6 470pF
T2 OSC.
C7 200 pF
C8 200 pF
C9 3-30pF
T3:IFT
T3A IFT
R8 15kΩ
C10 470pF
Tr2 OC169
C11 ·012μF
R6 3·9kΩ
C13 ·047μF
C12 270pF
T4 IFT
R9 10kΩ
R7 1·5kΩ
C14 100μF
R22 120Ω
D2 OA80
C15 ·01μF
R10 120Ω
R12 4·7 kΩ
R11 1kΩ
C16 10μF
C17 10μF
R13 150kΩ
Tr3 OC75
R14 5kΩ
R15 1kΩ
C18 100μF
R16 2·2kΩ
R17 1·5kΩ
C19 ·002μF
T5
T6
Tr4 OC74
Tr5 OC74
C20 ·002μF
R20 82Ω
R21 NTC 130E
R23 4·7Ω

The circuit as published by Mullard. Points of note are the use of only five transistors and the rather unusual AGC system using the OC75 as a DC amplifier. Power output is over half a watt.

mately equal to 5 uV measured through a 400 ohm dummy load into the aerial coil of a typical valve receiver.

Audio frequency stage design is conventional except for the use of the OC75 concurrently as the audio driver and as an emitter follower DC amplifier for AGC. The OC74's are biased to a quiescent current of 5mA by a voltage divider network incorporating an NTC resistor for DC stabilisation.

In order to limit spread in quiescent current, a variable resistor (R17) is recommended. However, it is possible to select a fixed value for R17 and change the value in the course of manufacture in those cases when the quiescent current may be out of tolerance.

To limit the spread in audio stage gain, 6 dB of negative feedback is applied via R13. Since the value of this resistor is too high to disturb the operating condition of the driver transistor, a blocking capacitor is not required.

The low impedance diode OA80 is used for high detection efficiency. In order to limit the change in detector circuit impedance with signal level it is given a forward bias of 90 mV by means of a potential divider network.

The receiver selectivity at high field strength when the antenna circuit is damped is determined by the selectivity at 455 kc/s.

IF AMPLIFIER

An IF amplifier design of low cost was attempted using a simple isochronous transformer instead of a bandpass filter between Tr1 and Tr2. The skirt rejection of this circuit was:

± 3 kc/s	5.2 dB
± 10 kc/s	17.7 dB
± 20 kc/s	32.4 dB

It will be seen that the selectivity is relatively poor, the worst consequence of which is the prevalence of heterodyne whistles over a band of frequencies centred upon the second harmonic of the IF. However, the limits of selectivity obtainable with a carefully designed pair of isochronous tuned circuits (Qo being equal to or greater than 200) were not attained in this experiment, and improved results could be obtained at the expense of audio frequency response.

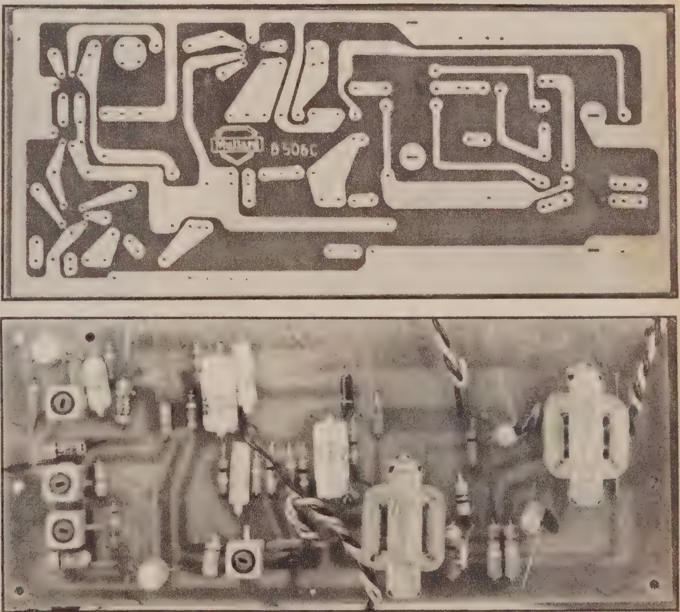
(Editorial Note: While the above reference to skirt selectivity is significant in regard to heterodyne whistles, etc., our own impression is that the response is quite sharp at resonance, to the point where it is inclined to prejudice the use of the simple direct drive type dial, normally a natural choice for a low-cost receiver of this kind. A more desirable characteristic would seem to be one having a tendency to a flat top and steeper skirts, at least to the extent that this can be achieved within the basic design.)

As has been stated, the OC75 driver is used as a DC power amplifier for AGC purposes, being required to produce a change of two volts across 1,000Ω. It is required that AGC action should begin at a field strength of approximately 2 mV/m, when the signal/noise ratio is 40 dB, and maintain control to a maximum field strength of 1 V/m.

An OA80 diode, placed in parallel with part of the aerial winding and drawing a current of 300 μA is used to produce this reduction in gain. The total change in voltage across the mixer base potential divider, diode and 1,000Ω filter resistor is then 1V (the voltage at the mixer base being used to provide the necessary AGC delay).

This method of automatic gain control is preferred to the customary practice of changing the operating condition of one or more IF amplifiers.

The latter has the disadvanatge that a change in transistor operating conditions produces a change in input and output admittance, thus detuning the IF transformer. A further disadvantage is



Top picture shows the printed wiring board as purchased. Lower picture shows the completely assembled board. Note that the two emitter resistors in the lower right corner should be replaced by a single resistor.

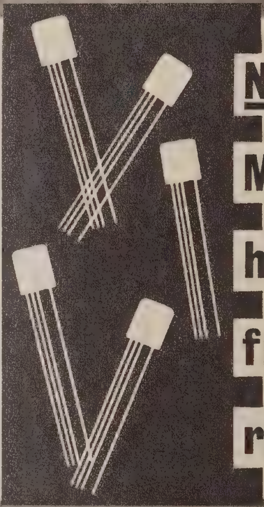
Mullard Alloy Diffusion Technique

high frequency transistors for cordless radio receivers

One of the most important recent advances in transistor technology is the alloy-diffusion technique used by Mullard. This technique provides transistors with uniform high frequency characteristics and enables the design of low cost cordless radios of superior performance.

OC169 - OC170 - OC171

Transistor Type	OC169	OC170	OC171	
Collector Voltage (Vcb max.)	—20	—20	—20	V
Collector Current (Ic max.)	10	10	10	mA
Max. Dissipation (25° C)	80	80	80	mW
Typical parameters at (measured at Vce = —6V, Ic = 1mA)	0.45 (common emitter)	10	100 (common base)	Mc/s
Input Conductance	0.4	2.5	23	mmhos
Input Capacitance	80	65	—6	pF
Feedback Admittance	< 100	100	600	μmhos
Transfer Admittance	36	32	14	mA/V
Output Conductance	7	60	350	μmhos
Output Capacitance	7	4.5	2.6	pF
Ideal Unilateralised power gain	61	32	< 10dB	



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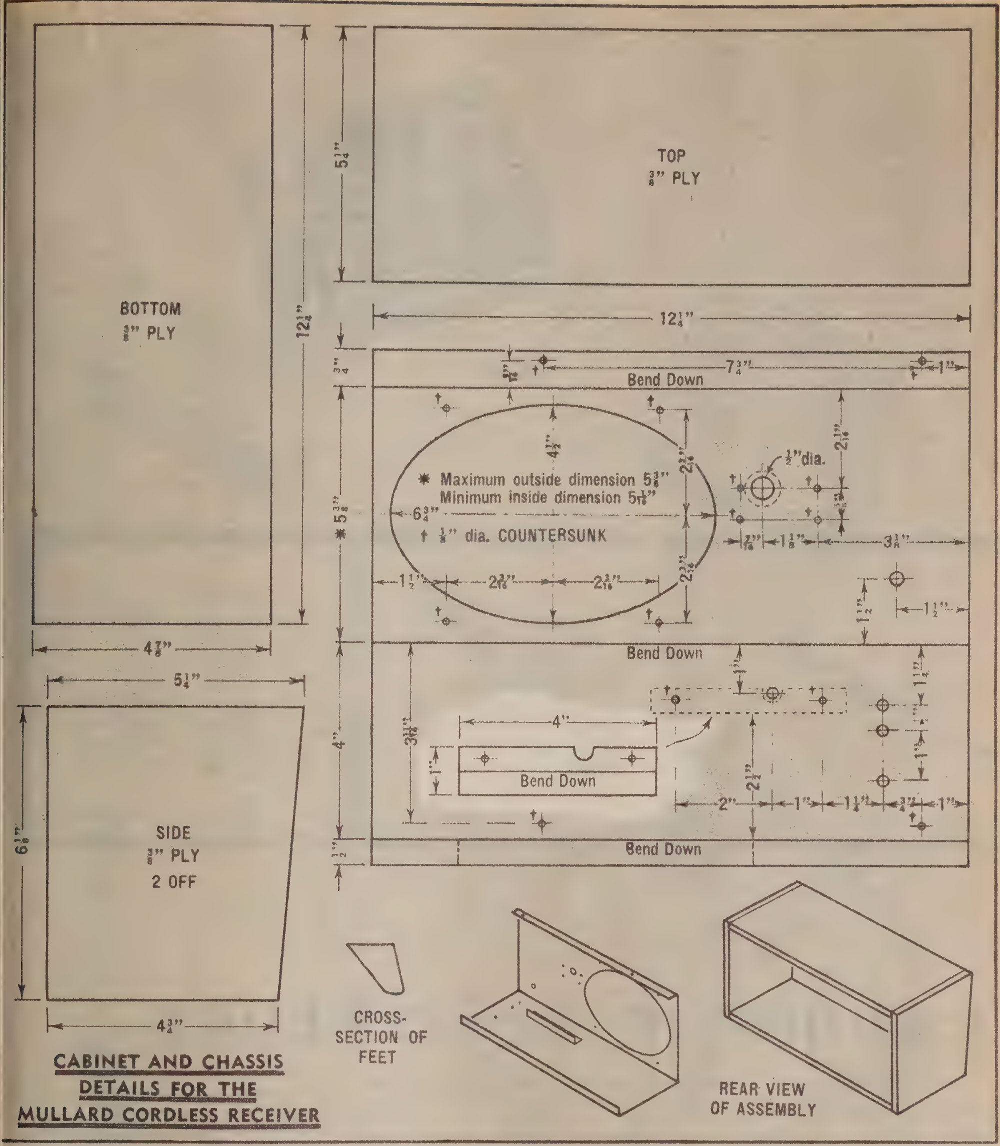


CABINET AND CHASSIS DETAILS FOR THE MULLARD CORDLESS RECEIVER

This drawing gives all necessary dimensions and details for construction of both the cabinet and chassis. The cabinet may be finished with Laminex or similar material, with anodised aluminium moulding on the front edge.

at a reduction in emitter current does ot necessarily result in the required duction in gain.

"Double spotting" effects on strong gnals, which are so prevalent in transtor receivers using conventional ethods of automatic gain control, do ot appear in this receiver.

The AGC characteristic will limit the udio to a 3 dB variation in output level ver the range, 1.8 mV/m to 630 V/m.

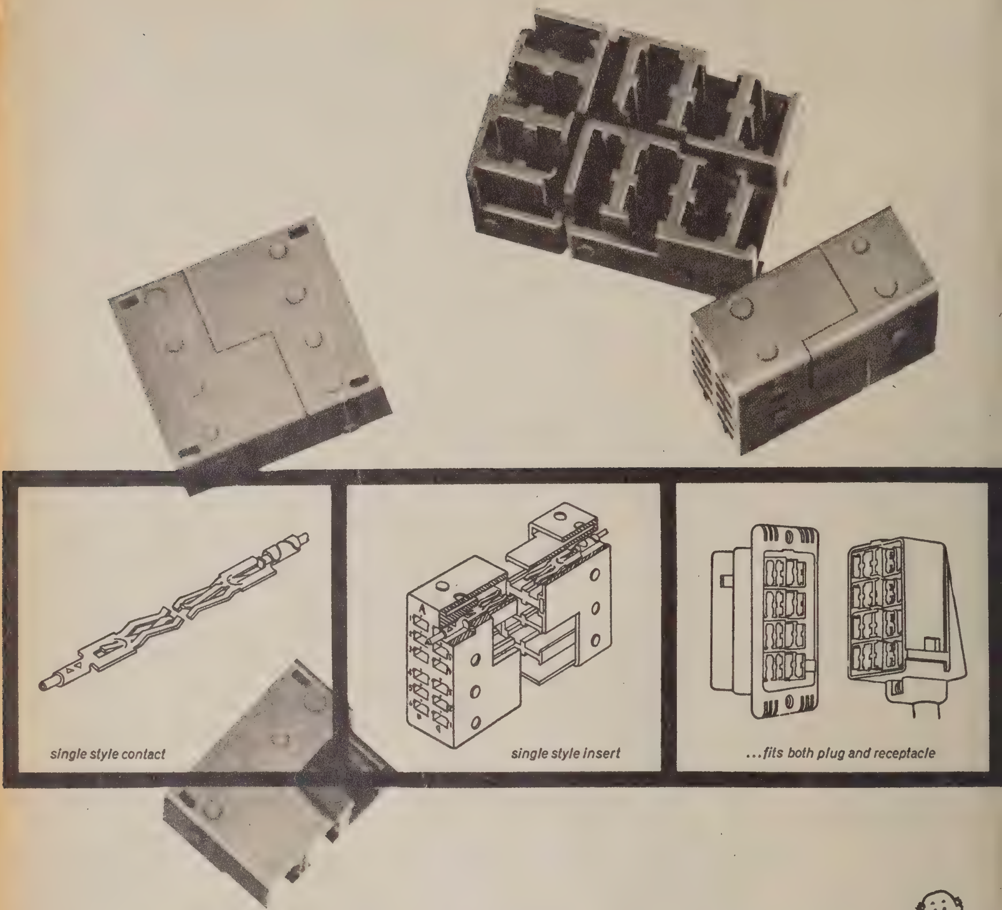
Current drain from a 9 volt battery aries from 14 mA under no-signal conitions to 105 mA at 500 mW output, e latter figure representing audio peaks f short duration.

So much, then, for the basic circuit. We must now consider the best way to use this. What is a good size and style of cabinet? How big a speaker can we use within the limits of this style? What is the most economical size battery? What is the best way to fit it all in so as to provide a logical layout, reasonable accessibility, and an attractive frontal view? These, and a host of minor questions had to be considered.

We took as a basis for experiment the attractive cabinet design originally specified for the 1961 Little General (June, 1961), a happy choice as it turned out. In it we were able to accommodate a high efficiency 5in x 7in oval speaker, the battery manufacturer's recommended type of battery, and the printed board exactly as specified. In addition, we were able to reduce the cabinet depth slightly.

Basis of the assembly is an "L" shape chassis, one leg of which becomes the front of the cabinet. This section supports the speaker, the tuning capacitor, the volume control, and one edge of the printed board. The other leg sits on the bottom of the cabinet, provides a simple clamp for the battery, and supports two 1/8in rods which, in turn, support the rear edge of the printed board.

The dial is a simple direct drive unit, featuring a small central knob and a large transparent disc through which the



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ation calibrations are visible. The disc so serves as a fine tuning knob, the rge diameter offsetting in some degree e lack of a reduction gear.

As a finish for the front panel we ose a new product; perforated uminium with a gold anodised finish d rubber backing, the latter to elimin- e any possibility of metallic rattles. It easy to handle, provides an attractive ish and is very durable.

As a decorative feature for the panel, added a row of polished black but- ns, actually black upholstery nails with e pins clipped off and fastened in place th contact adhesive.

ABINET DETAILS

The cabinet is constructed from 3/8in ywood, covered with wood-grained minex or similar material. All dimen- ns etc. are given in the accompany- drawing and the average reader ould have no difficulty in constructing with ordinary tools. For those who uld like more details, we recommend e article in the June, 1961, issue.

However, one of the main features of s design is the use of anodised alumin- n moulding to finish the front edges. any styles are available to suit a variety tastes, but "Schock" style 1039 appears be a good choice.

At the time of writing, at least one of r advertisers (Watkin Wynne Pty. Ltd.) planning to market a kit of comprising ils, transformers, tuning capacitor, inted board, chassis, cabinet, dial, and nor items of hardware, or to supply ese items separately. Others may have nilar kits to offer, so that the home nstructor should have no difficulty in taining any item he requires.

The first step in assembly is to mount e speaker on the front panel, and this ust be done before the decorative uminium panel is fitted. Once this is ne the mounting screws will be inacces- le from the front and, for this reason, ey must be secured with an extra nut fore the speaker is fitted. The mount- g holes in the speaker gasket are large ough to accommodate these nuts, and a cond set is used to hold the speaker elf. Screws are 3/8in x 1/8in counter- nk.

ANG MOUNTING

Countersunk screws are also used to ount the tuning capacitor, but in this se clearance holes may be drilled in e decorative panel, since they will sub- quently be hidden by the dial scale. e gang probably will need to be set ck from the panel by the thickness two plain washers and, on this basis, n long screws should be used. Any- ng longer may foul the fixed plate embly.

An alternative method of gang mount- provides rubber insulation from the in chassis, and this will be useful if y trouble is experienced with gang crophony at high volume levels. In s arrangement the gang sits on four ber feet, supported in turn on a simple " shape bracket bolted to the front nel. The larger leg is approximately o inches square, the smaller one being out ¼in, or sufficient to bolt on to front panel.

The layout is such that there is room ly for one bolt in the area hidden the dial scale. However, if both tal surfaces are given a coat of con- t adhesive before assembly, the job l be quite rigid.

The four rubber feet are made from normal gang mounting rubbers, sliced in two through the groove, and the thinner sections used. They are fastened to both the gang and the bracket with contact adhesive, a process which saves a lot of hardware and fiddling. In fact, this arrangement is so simple that many builders may prefer to adopt it as a matter of course.

(Don't forget that the gang, once rubber mounted, will need a separate chassis connection. A short length of hookup wire to any convenient point will do.)

The decorative aluminium panel should be cut so as to make it a neat fit inside the cabinet and mask any slight inaccuracy in the chassis size. An oval section of the rubber backing is cut out to correspond with the speaker opening in the chassis, after which it is fastened to the chassis with a suitable glue. Contact adhesive or rubber cement is suitable.

The dial scale is of aluminium, supplied with an adhesive backing and protective paper. Since the adhesive "takes" instantly, it is a good idea to line things up before the protective paper is removed, making light pencil marks to serve as a guide. The scale can be removed and replaced but considerable care is necessary.

PRINTED BOARD

The printed board is anchored to the lip of the front panel by two countersunk screws, approximately 5-16in long, with a ¼in long spacer interposed in each case.

So far we have said very little about the actual wiring of the board, mainly because this should amount to little more than a routine operation. The printed board as bought should have all the necessary assembly instructions either printed on the reverse side, or on an accompanying sheet. This, together with the accompanying photographs, should make everything quite straightforward.

However, the board in the set shown here is one of the developmental models submitted to us by Mullard, and contains one or two minor features which were subsequently modified. One of these is a run of copper in the vicinity of R2 and R8 which is no longer needed or provided.

Another concerns the emitter connections to TR4 and TR5. As shown in the circuit and provided for in the current boards, these are joined together and connected to earth through a 4.7 ohm resistor. This is now the preferred arrangement, rather than the one shown in which each emitter uses a separate resistor.

Finally, in regard to soldering on printed boards. While these will stand a reasonable amount of heat, prolonged heating should be avoided and, in fact, should not be necessary. Also note that the space between some conductors, particularly near the coil pins, is quite small. A small iron and reasonable care is essential to avoid "shorts."

PLANETARY DRIVE

Since testing the set in its original form, we have had the opportunity to try an alternative dial drive, based on a planetary reduction gear. For those who prefer something more elaborate than the direct drive this would appear to be the answer. It may be fitted initially or as a modification at a later date.

Depth of the drive unit is approximately one inch, and three spacers of this length with suitable screws will be required to set the gang back from the panel. (Only three mounting holes can be used in this arrangement.) The spacers may be conveniently cut from brass tube of approximately ¼in diameter.

The panel hole will need to be enlarged to ¾in and an additional 3/8in countersunk hole drilled to accommodate an anchoring screw for the drive mechanism. This latter may be anywhere that is convenient on a 5/8in radius from the shaft centre.

The new position of the gang will mean that the battery can no longer be fitted or retained in the simple manner as before. We suggest that the rear lip of the chassis be cut away for the length of the battery, and that the latter be retained by a strap, spring, or similar device, possibly strung between the two board supporting pillars.

If it is desired to rubber mount the gang, this can still be done by making the "L" bracket about one inch longer. The only other change is to anchor the planetary drive mechanism to the gang, rather than the front panel.

This should cover most of the mechanical and electrical problems likely to be encountered with this set, with the possible exception of alignment. There is nothing special about this and we have covered this process many times in the past. If you don't feel equal to it, it would be better to pass it over to someone with the necessary equipment and experience.

TV COLOUR STANDARDS

(Continued from Page 19)

Further, if we are to have new line standards, there are some features in the colour system that would merit reconsideration. It is to the Americans, and to the Radio Corporation of America in particular, that we owe the immediate possibility of a colour service, but the American colour standards had to be forced into the strait-jacket of their existing monochrome standards.

This introduced certain limitations which we should like to see relaxed.

Finally, there comes the question of the colour receiving tube. Among the various break-throughs which the Americans achieved in their colour work, nothing is more outstanding than the R.C.A. tricolour tube.

But this tube is difficult to make and difficult to adjust and to hold in adjustment. This makes colour receivers expensive in cost and maintenance.

Much work is going on, but in practical terms no alternative colour tube has yet been achieved.

Let me summarise with some questions and answers:

How soon could we have a colour television service?

Certainly within a year, on existing line standards.

What will an existing monochrome set make of colour transmission?

A monochrome picture.

Will a colour set also accept monochrome transmission?

Yes, but the picture can be much inferior.

How much will sets cost?

About twice that of a monochrome set, size for size.

Are costs likely to be much higher than this at first?

This depends on how much manufacturers like to lose!

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38. Transistor 2
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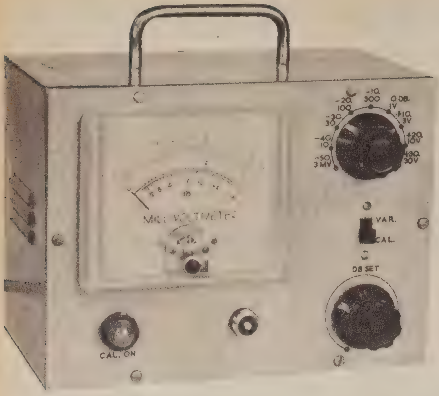


BUILD THIS NEW MILLIVOLTMETER

By Jamieson Rowe

Here's a new measuring instrument which will be of considerable interest to audio enthusiasts. With a frequency response well over the audio spectrum and a sensitivity of three millivolts full scale on the lowest range, it will permit direct output measurements to be made on pick-ups, microphones and tape heads. A decibel scale allows comparative measurements of more than 90dB to be made.

MANY sources of signal in the audio field have output voltages less than 100 millivolts. For example, crystal microphones generally deliver from 15 to 150 millivolts. Lower than these are magnetic pickup cartridges and tape heads, which may deliver two or three millivolts.

If the performance of these devices is to be assessed, problems may arise. In the absence of suitable instruments, the old "try by ear" method is often used. A convenient amplifier is connected to the device to be tested, and the output compared in "tone" and volume with another device of "known" performance.

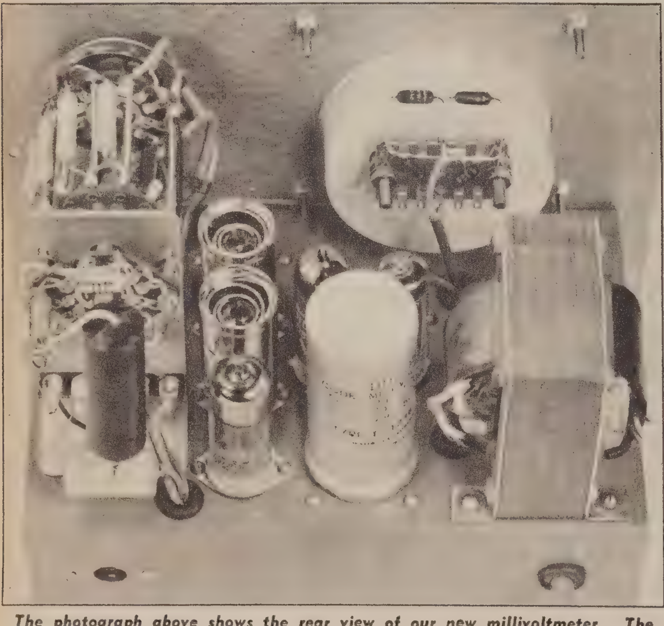
Fairly obviously, however, this method has serious disadvantages. Variations in loading and loading effects, testing procedure, room acoustics and subjective effects in the person involved create quite appreciable errors.

High sensitivity moving-coil instruments may be used, but their loading effect and dubious frequency response tend to cloud the results considerably. The normal type of VTVM does not introduce loading troubles, but seldom has sufficient sensitivity (most going down to only 3 volts full scale).

A suitable amplifier of known good response may be used to build up the output from the device under test, to enable the VTVM to be used. Th method is quite often used, and ma produce satisfactory results. Howeve it still leaves errors due to amplifie variations, loading, etc., which tend t detract from the reliability of the te results.

There is thus quite a strong case fo an instrument such as the one which described on these pages. An AC mill voltmeter having a sensitivity on th lowest range of 3mV full scale, allows direct and accurate measure ment of the actual output from lo level signal sources. The frequenc response of the instrument is quite fl over the entire audio spectrum, so th the actual frequency response of th device considered may be determine easily and without ambiguity.

In addition, since the effective inp impedance is very high (approx. 6 megohms shunted by 6 pF) the loadin effect of the instrument is negligibl Thus the unloaded output characterist of a particular device may be found well as the effect of controlling the lo impedance by known amounts.



The photograph above shows the rear view of our new millivoltmeter. The range switch is at the left, with the feedback components at the rear. Next may be seen the valves, the triple 24 mfd can electrolytic, and the power transformer. When this shot was taken, a meter protection diode (later replaced by the 100 mfd electrolytic) was connected across the meter terminals.

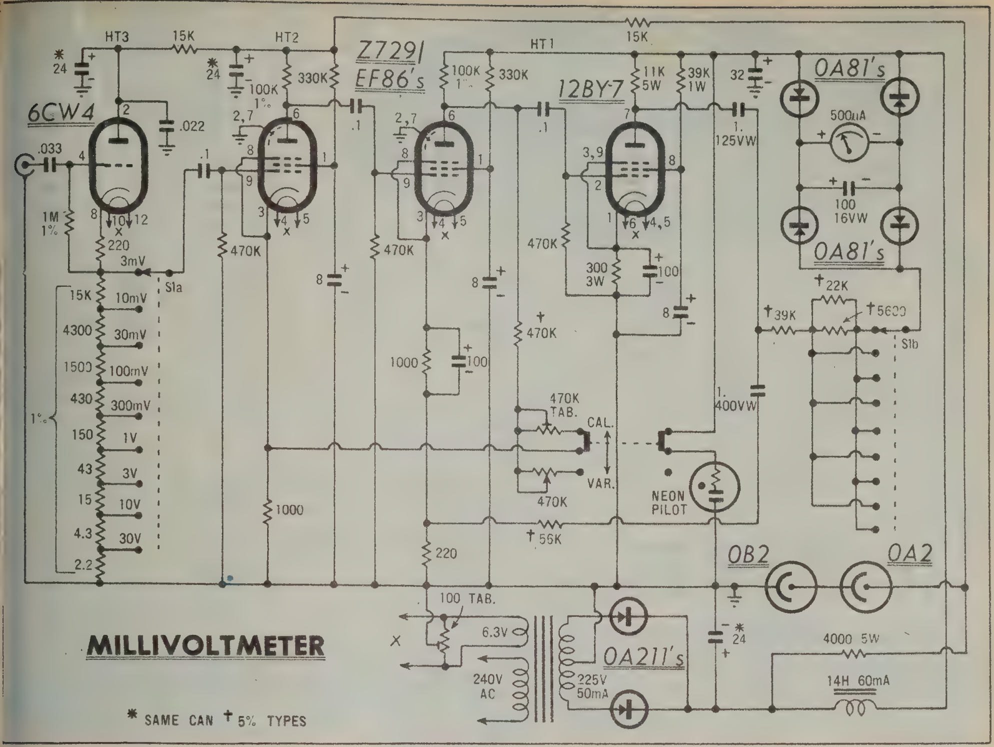
STUDY OF CIRCUIT

A study of the circuit diagram shou help in understanding the operation the instrument. Basically it compris a four-stage resistance-capacitan coupled amplifier followed by a dete tor and meter circuit.

The first stage of the amplifier is cathode-follower (common plate) circu using a 6CW4 nuvistor triode. T cathode follower configuration provid the required high input impedance the instrument, while allowing ran switching to be carried out at low i pedance. Thus the range switchi divider in the 6CW4 cathode circuit effectively freed from hum and str capacitance frequency-conscious effec

The range switching divider allo any input within the capabilities of t cathode follower to be reduced to amplitude suitable for the followi amplifier stages. The higher the inp voltage, the greater the division rat Precision resistors are used in t divider chain to allow accurate ran division and to reduce, to a certa degree, thermal noise.

The nuvistor triode is used as input cathode follower because t nuvistor construction provides hi


MILLIVOLTMETER
* SAME CAN † 5% TYPES
6CW4
Z729/EF86's
12BY7
0A81's
500uA
0B2
0A2
0A211's
HT3
HT2
HT1
15K
330K
100K 1%
470K
1000
220
3mV
10mV
30mV
100mV
300mV
1V
3V
10V
30V
S1a
S1b
CAL.
VAR.
NEON PILOT
470K TAB.
100 TAB.
6.3V
240V AC
225V 50mA
4000 5W
14H 60mA
1. 400VW
1. 125VW
100 16VW
11K 5W
39K 1W
300 3W
22K
39K
5600
56K

Here is the circuit of the instrument. Basically a four valve amplifier with calibrated gain followed by a detection and metering circuit, it allows accurate measurement of tiny AC voltages. Power is supplied by a full-wave circuit using silicon diodes, and gaseous voltage regulation is used for the first two stages. A 6CW4 'nuvistor' triode is used in the input circuit to reduce noise and increase reliability.

transconductance with low internal capacitance. It also increases calibration stability and reduces noise and microphony — desirable characteristics in an instrument of this type.

From the range setting switch the signals pass to a pentode amplifier stage utilising a Z729/EF86 valve. This valve was also chosen because of its relatively high slope and low noise. The noise is further reduced by the use of a deposited carbon precision resistor as the anode load and by the action of negative feedback.

The 1K resistor raising the valve cathode from earth potential gives the stage a controlled amount of negative current feedback, which is non-frequency selective and used for stabilisation. To prevent further degeneration in gain due to screen voltage variations, the screen should be kept at earth potential as far as AC is concerned. A large by-pass capacitor does this, remaining a low impedance until very low frequencies are reached, and keeping the stage response level at that set by the cathode resistor degeneration.

The third stage of the amplifier is similar to the second and incorporates a Z729/EF86, again used as a pentode amplifier stage. A deposited carbon resistor is suggested for the anode load, and heavy screen bypassing is included.

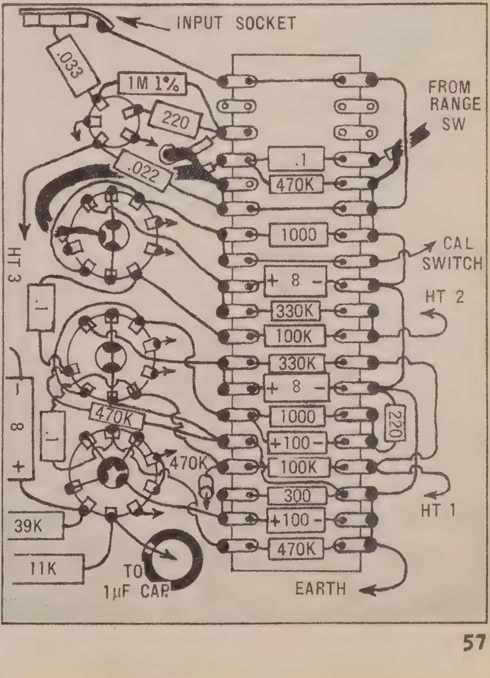
Negative feedback is arranged over the second and third stages to improve gain stability and frequency response. Sensitivity adjustment of the instrument is carried out by controlling this feedback within moderate limits. Two alternative adjustments are provided, one a preset control at the rear and the other a control on the front panel. A switch selects the one desired and operates a neon indicator in the present mode of operation.

The idea behind the two modes of operation is one of convenience. The preset sensitivity mode allows accurate measurements to be made with the instrument held to a preset

☆

For the assistance of readers unfamiliar with the wiring techniques and layout of an instrument of this type, we provide this wiring diagram of the valve sockets and resistor panel.

☆


INPUT SOCKET
.033
1M 1%
220
.022
.1
470K
1000
+ 8 -
330K
100K
330K
+ 8 -
470K
1000
220
+100-
470K
100K
300
+100-
470K
39K
11K
TO 1μF CAP
FROM RANGE SW
CAL SWITCH
HT 2
HT 1
HT 3
EARTH
.1
.1
8

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alibration. For some applications, howver, it is convenient to be able to vary he absolute sensitivity of the instrument ver a small range as, for example, to vork from "0db" at some reference freuency. The variable sensitivity mode llows this to be done, while retaining he accurate relationship between the arious ranges.

From the output of the third stage, the ignals pass to the last stage. This is a entode amplifier using a 12BY7 high erveance pentode. A fixed negative feedack loop is provided from the 12BY7 utput back to the cathode of the third tage, to improve frequency response and ain stability.

METER CIRCUIT

The final amplified signal appearing at he 12BY7 anode is passed to the meterng and detection circuit. This is basically 500-micro-amp moving coil meter novement connected to a conventional ull-wave rectifier bridge using four OA81 liodes (or similar).

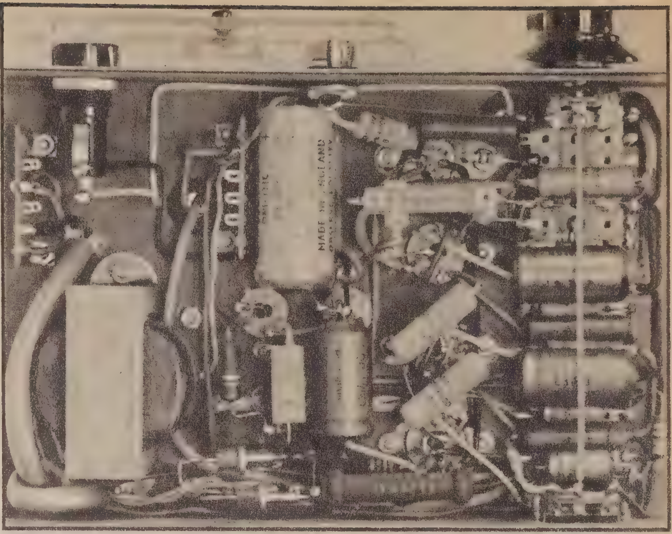
To protect the meter against sudden verload current surges it is shunted by 100 mfd electrolytic capacitor. For ormal operation, the capacitor has no ffect, as the meter voltage is effectively onstant. If the meter voltage tends to ise quickly due to a transient, however. he capacitor impedance falls due to its harging current and thus effectively hunts the meter.

Thus nearby switching transients or acidental overloads, which tend to be icked up by a sensitive instrument of his type, are prevented from causing neter damage.

The final frequency response of the nstrument, as indicated by those frequencies at which the meter reading falls y 1dB from its middle-frequency value, aries at the high end. The worst case is n the 10mV range, where the upper 1dB point is 65Kc. Next come the 30 and 100 mV ranges, with an upper limit of pproximately 75-80 Kc. All other ranges ave an upper 1dB point of approxinately 110Kc. The lower 1dB point on ll ranges is the same, and is approxinately 12-15 cycles-second.

The metering circuit is connected from the 12BY7 anode to the HT line, rather than the usual anode-to-earth connection. This makes no difference to the meter reading, since the HT line is effectively at earth potential (being heavily bypassed to earth as far as AC is concerned). Referring the metering circuit back to the HT line, however, removes the large switching-on surge usually experienced due to coupling capacitor charging.

The reasoning proceeds thus: when the instrument is first switched on, the HT line builds up in potential very quickly, due to the silicon diode rectifier system. Thus until the 12BY7 valve warms up, its anode is at full HT potential with respect to earth.


This view of the underside of the chassis shows the filter choke on the left, and the resistor panel on the right mounting the amplifier components. Note the 100-ohm slider potentiometer used to balance the heater supply with respect to the valve cathodes.

If the metering circuit were connected via the lmfd coupling capacitor to earth, the capacitor would thus draw a considerable charging current in order to develop a voltage equal to the anode potential. The meter needle would thus swing violently against the stop whenever the instrument was switched on.

By referring the meter circuit back to the HT line itself, however, this effect is very much diminished. It is not entirely removed, since the 1 mfd feedback coupling capacitor draws charging current. Most of this current flows through the 1 mfd coupling capacitor attached to the anode, however, which leaves a very small amount to affect the meter.

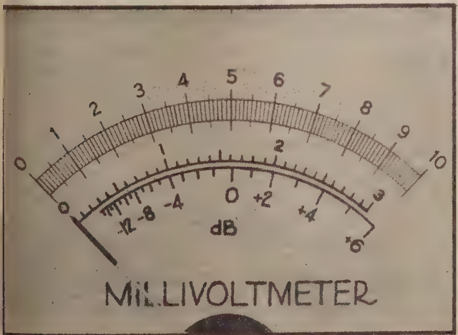
A 39K resistor is used to provide a meter multiplier resistor for all the ranges using the 0-10 scale of the meter (i.e., the 10mV, 100mV, 1V and 10V ranges). For the ranges using the 0-3 scale of the meter (3mV, 30mV, 300mV, 3V and 30V) a further multipher consisting of 5.6K and 22K resistors in parallel is switched into circuit.

The reduction in meter sensitivity for the 0-3 scales is done so that there is an exact 10 dB relationship between adjacent ranges. Since a signal 10 dB higher than 3 volts is not 10 volts but 9.5 volts, to provide the exact inter-range 10 dB relationship the 0-3 scale must be shortened to 0.95 times the length of the 0-10 scale.

This means that a single decibel scale on the meter will serve all ranges of the instrument. Switching from range to range merely involves adding or subtracting 10 dB each time.

Power for the instrument is supplied via a 225-0-225 volt power transformer and two OA211 silicon diodes used in a conventional full-wave circuit. From the rectifier output a 14-henry 60-milliamp filter inductor and a 32 mfd electrolytic capacitor provide HT for the last two stages of the amplifier.

To supply the first two stages of the amplifier, a 250 volt gaseous voltage regulator circuit is taken directly from the rectifier output. The regulated voltage of 250 is achieved by connect-



At left is the meter panel of the prototype instrument. We understand that meters carrying suitable scales will be made available shortly by at least two local manufacturers. (The prototype used a Ferrier meter.)

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2 meg. + 2 meg. Tapped at 40K W/Switch concentric	5/6 ea.
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PARTS LIST

- 1 **Case, front panel and chassis. 9in x 6½in x 5½in.**
- 1 **Power transformer 225-0-225 volts, with 6.3 volt 2 amps.**
- 1 **Filter choke, 14 Henry 60 mA.**
- 1 **Meter, 4-inch type, 500 microamp.**
- 1 **Rotary switch, 2-pole 11-position with dummy wafer to support resistors.**
- 1 **Slider switch, 2-pole 2-position.**
- 1 **240-volt neon panel indicator.**

VALVES AND DIODES

6CW4, 2 x Z729/EF86, 12BY7, OB2, OA2, 2 x OA211, 4 x OA81 or similar.

RESISTORS

1 per cent deposited carbon: 1 meg, 2 x 100K 1 watt, 15K 1 watt, 4.3K, 1.5K, 430 ohm, 150 ohm, 43 ohm, 15 ohm, 4.3 ohm, 2.2 ohm.

5 per cent: 5.6K, 22K, 39K, 56K, 470K.

Also 2 x 220 ohm, 1 x 300 ohm 3 watt, 2 x 1K, 1 x 4K 5 watt, 2 x 15K 1 watt, 1 x 39K 1 watt. 2 x 330K 1 watt, 3 x 470K, 100 ohm slider pot, 470K carbon pot, 470K tab pot.

CAPACITORS

Plastic or paper: 1 x 0.022 mfd 400V, 1 x 0.033 mfd 400V, 3 x 0.1 mfd 400V, 1 x 1 mfd 125V, 1 x 1 mfd 400V, 3 x 8 mfd 400V electrolytics, 3 x 24 mfd electrolytic (single can for the three), 1 x 32 mfd 400V electrolytic, 3 x 100 mfd 16V electrolytic.

SUNDRIES

Input connector, 19-tag length of resistor strip (miniature type), 1 x 5-lug tagstrip, 2 x miniature 6-lug tagstrips, 1 miniature 8-lug tagstrip. 7 grommets, 2 knobs, length of shielded microphone cable, connecting wire, quantity of nuts, bolts, solder, etc.

A 100 ohm slider potentiometer is tted across the heater supply with the iding connection earthed. This allows ie cancellation of heater-cathode in-uced hum by enabling the heater lines be suitably balanced or unbalanced ith respect to earth.

Note that the earthy side of the instrument circuitry is linked to the chassis and case at only one point, and is otherwise insulated from it. This is done to prevent the formation of earth loops and consequent hum or instability.

On the mechanical side, the instrument built in a standard small instrument ase measuring 9in x 6½in x 5½in. The ieter and function switch are mounted n the front panel, together with the "Variable-Calibrated" sensitivity mode switch, the variable sensitivity control, the input connector and the calibrate pilot lamp.

As the rear photographs show, most of the larger components are mounted above the U-shaped chassis. At the lower right is the power transformer, directly behind the meter. Alongside it at the rear of the chassis is the triple 24 mfd electrolytic can, with the two voltage regulator tubes in front.

Next along the chassis are the amplifier valves. The 6CW4 nuvistor is at the front (hidden), then the first and second EF86, and finally the 12BY7.

At the end of the chassis is the range switch, supported at the rear by an aluminium bracket. This also serves as a shield between the divider and meter multiplier sections of the switch. Note the small tagstrip near the bottom of the bracket to support the two 1 mfd capacitors, and a small plastic standoff post mounted at the rear of the switch to support the junction of the feedback 1 mfd capacitor and the 56K resistor.

The range switch is basically a standard two-section, rotary type having each section a 1-pole, 9-position wafer. A dummy wafer is used 1¾in behind the front wafer to support the range resistors. Half an inch behind this is the support bracket, with the second active wafer 3-8in behind this again.

Underneath the chassis, we have the filter choke on the left, behind the "Calibrate On" neon indicator. Most of the small components associated with the amplifier are mounted on a section of miniature resistor panel along the right-hand end of the chassis, next to the line of valve sockets.

The wiring of the amplifier circuitry may be somewhat of a problem to readers unaccustomed to instruments of this type. Therefore, we have prepared a wiring diagram of the resistor panel to assist in the laying-out and wiring.

When the wiring is completed, the instrument should be turned on and the heater balancing potentiometer adjusted for minimum meter reading with shorted input. This should be done with the range switch set to the 3mV position to ensure correct balance on all ranges.

The instrument should then be calibrated in the "Preset" position by comparing it with a standard meter of known accuracy. A normal multimeter may be used providing it is known to be accurate, with the sample voltage derived from a spare heater transformer, etc.

With the amplifier sensitivity set by means of the feedback preset control, adjust the input voltage so that a reading of 3 volts (or a multiple) is obtained. Then turn up or down a range (as the case may be) to check that 3 volts is still indicated. This will show whether the 0-3 and 0-10 scales have the correct relationship, governed by the auxiliary meter multiplier.

Since the resistors concerned (the 5.6K and 22K) are 5 per cent types, the relationship should be quite accurate enough for most purposes. However, if a slight error is evident it may be corrected by varying the value of the 22K resistor. If the 0-3 range reads a trifle high, experiment with the next highest value handy. Conversely, a value lower than 22K would be indicated if the 0-3 range reads slightly less than it should.

This completes the description of our new milli-voltmeter. It should find considerable application in the testing of pickups, microphones, tape heads and similar low-level circuitry.

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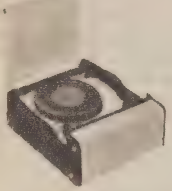

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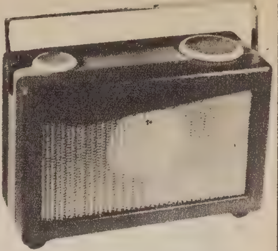

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CAVITIES, KLYSTRONS, “PLUMBING” *and all that..*

Since the war years there has been a steady stream of radio disposals equipment on to the market through various sources. Some of this equipment, naturally enough, has been of little use outside the type of service for which it was designed. For this reason such gear has become only a source of spare parts, or else clutters up otherwise usable space around the shack.

By Alan Nutt

Pictured is a complete 10,000Mc. transceiver suitable for amateur operation and using currently available disposals radar equipment. The tripod mounting makes for ease of alignment but is unnecessary except for long-distance operation where adjustment becomes more critical.

AT the other end of the scale various items have proved so valuable, for one reason or another, that they are keenly sought after.

Until recently, most apparatus coming from radar installations fell into the first category. This is understandable for a number of reasons.

Firstly, apart from a few useful valves and other easily recognised components, little use could be found for the various pieces of “plumbing” and other strange devices usually associated with this type of equipment. Only those familiar with radar operation could recognise TR switches, duplexers, klystrons, magnetrons and all the other paraphernalia.

Fewer still saw the possibility of using this equipment in an amateur installation or, if they did, dismissed the idea as impractical due to lack of interest in other quarters. After all, it's not very thrilling to call “CQ, 10,000 megs!” when one knows perfectly well that there is not the slightest chance of anybody hearing the call. One might as well give up and go back to 80 metres!

CHANGING PATTERN

However, due to a number of factors, it would seem that the pattern is changing. Crowded conditions on the lower frequency bands, decreasing sunspot activity with the consequent reduction in DX operation, and increasing interest in VHF and UHF activities generally are just some of the reasons for the additional activity on bands that were, a few years ago, amateur in name only.

As this interest increases, and there is little doubt that it will, many amateurs will begin to wonder if, after all, there may be some use for those strange items of equipment that have been decorating the shack and gathering dust over the years. It is the purpose of this article to describe some of these unfamiliar pieces so that they may be easily recognised and their “ham” potential evaluated.

At the same time, we hope to explain some of the general principles involved in microwave technique so that the reader may become familiar at least with the “how,” if not the “why,” of operation.

It is quite unnecessary to approach the subject at an advanced engineering level before being able to put a signal on the air. Indeed, if this were the case, even the lower frequency bands would be very sparsely populated! As the majority of amateurs will testify, advanced academic qualifications are not an essential for operating a station and the same conditions apply at microwavelengths, provided certain basic concepts are grasped.

MENTAL PICTURES

No basic theories need be changed but our ideas or concepts of those theories may be. We are used to conjuring up certain mental pictures of volts and amps, inductance and capacitance, etc., and this is all to the good if it truly helps us to understand their working.

However, such pictures may well prove a hindrance when applied to microwave circuitry and it will be best if we realise from the outset that an idea may be approached from several different directions. It is necessary that we select the approach that will give us the clearest insight into that idea or theory.

Microwave designs differ from their low frequency counterparts in several fundamental points, notably, tuned circuits, the generation of RF energy and the transfer of that energy from one point to another.

Taking “tuned circuits” as a starting point for our discussion, we must clarify our thinking concerning the function of a simple coil and capacitor connected in a resonant circuit.

In a Hartley oscillator for instance, the L/C tank circuit performs three important functions: It determines the frequency of oscillation; it provides storage place where RF energy ma build up for transfer to the load; i conjunction with the valve, it provide a feedback voltage to the grid in th proper phase and at the correct impec ance, so that oscillation will be mair tained.

At microwavelengths it is still nece sary that the “tuned circuits” perforı identical functions, viz., frequency determination, energy storage and impedanc matching. The use of lumped constant that we can refer to as inductance c capacitance becomes quite impractica however, as we push the operating fre quency higher and higher.

REACTIVE PROPERTIES

Even at frequencies in the VH region, say around 150Mcs., very sho lengths of wire exhibit considerable r active properties and, if reasonable effic ency is to be maintained, wire sizes mus be increased. A little thought will mak it obvious that, at some higher poi in the frequency spectrum, the physica dimensions will be such as to render th construction of a “normal” coil quit impractical.

At frequencies above about 1000Mc coils and capacitors have well and trul been bowed out and even conventiona tuned quarter-wave lines are nearin their useful limit. And even apart fro the physical difficulties involved, radia tion from these types of tank circuit be comes so great that circuit efficienc drops to an impractical level.

This being the case, an entirely di ferent type of resonant circuit is em ployed at microwavelengths and, a though it may take one of several form is generally known as a resonant cavity The way in which a cavity may be de veloped from a conventional tuned ci cuit is best understood by considering th following physical analogy.

A typical UHF tuned circuit is show in Fig. 1a, consisting of a single induc tive loop connected across the two plate of a small capacitor. If we desire t raise the frequency, the inductance o the loop may be effectively decreased b placing a second loop in parallel wit it across the capacitor.

Further reductions may be achieve by adding additional loops in paralle until, carrying the effect to its logica conclusion, we arrive at a completel enclosed cavity as shown in Fig. 1b.

A cavity of this shape is known as

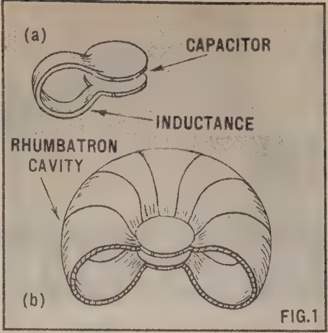


FIG.1

Illustrating the development of a resonant cavity from a conventional UHF tuned circuit. This type of cavity is known as a rhumbatron.

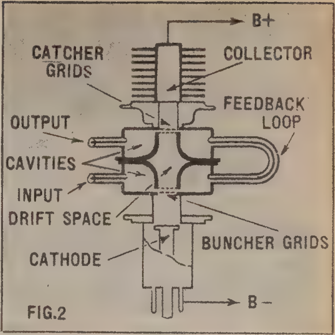


FIG.2

The simplified construction of a conventional two-cavity klystron is illustrated in the above diagram. Operation is discussed in the text.

rhumbatron or **re-entrant** cavity and finds considerable use in the generation of microwaves, as we shall see shortly.

We must be careful, however, not to carry this analogy of cavity development too far. The function of coil and capacitor are not so clearly delineated as our simple description would seem to imply. Additional capacitance effects exist between various parts of the loop as well as between the two original plates we called the capacitor.

These effects are of such a magnitude that any calculations which do not recognise them are generally worthless.

The fact of the matter is, apart from the use of the terms to denote phase relationships between electric and magnetic fields or voltage and current, the normal concepts of inductance and capacitance have little value in microwave discussions.

CAVITIES

Three general types of cavity are commonly employed and may be easily distinguished by their physical construction. A **co-axial cavity** is one which employs two co-axial conductors. A **waveguide cavity,** of which there are several forms, consists of an enclosed, hollow container of either cylindrical, rectilinear or spherical construction. The third type, a **rhumbatron,** has already been mentioned.

Co-axial cavities are usually associated with measuring equipment, more particularly with regard to frequency measurements. This is so because, over broad limits, the propagation velocity is independent of frequency. In other words, a wavelength as measured in the cavity will correspond with the actual free-space wavelength.

This fact is not true of the other types of cavity.

Waveguide cavities are the more generally used and perform a variety of functions. The frequency determining capability depends mainly on the physical dimensions, which can be held to close tolerances by accurate machining and extrusion processes.

If RF energy is coupled into an enclosed rectangular cavity, it will travel backwards and forwards along the cavity length, being reflected each time it reaches a closed end. After a period of time, the reflections will grow weaker until they finally disappear, all the energy having been dissipated in heat in the cavity walls.

OVERCOMING LOSSES

On the other hand, if we introduce a second pulse of energy into the cavity at exactly the instant at which the reflected wave is passing the input point, the original energy level will be boosted. The amount of additional energy coupled in can be regulated so that it just overcomes the losses caused by the wave travelling up and down the cavity. In this condition, the wave will travel backwards and forwards indefinitely.

It may be seen that, if energy is to leave the point of entry, travel to one end and return to the point of entry in just the correct time or phase to be reinforced by the next input pulse, the physical distance over which it must travel becomes an important factor, assuming the velocity of the wave to be constant.

This physical distance must be equal to a half wave length, or an odd number of half wavelengths, at the operating frequency. Just for the purpose of discussion we may say that energy travelling from the input towards the right-hand end of the cavity represents a positive potential or charge at the input. It then follows that energy travelling in the opposite direction would represent a negative charge at the input.

The original pulse, when reflected, is now travelling in the opposite direction which represents a phase shift of 180 degrees. At the moment it reaches the input point again, one half wavelength of time has elapsed and the input phase has also shifted 180 degrees so that reinforcement will take place.

The action of the rhumbatron cavity is very similar and its use will be explained in more detail a little later when we deal with methods of RF generation.

When a low frequency "tank" circuit is delivering energy into a load, its Q will be considerably below that measured in the unloaded condition. Figures in the vicinity of 10 to 20 are common for transmitter circuits while 150 to 200 are reasonable for receiver applications where the tuned circuit is not called upon to deliver power.

Compared with these figures, the Q of a resonant cavity is quite impressive. Unloaded Q may reach 10,000, dropping to something in the vicinity of 1,000 when loaded. For this reason, resonant cavities are often employed as bandpass filters. Energy coupled into one side of a cavity may be taken out at the other side, the transfer characteristic being exceptionally sharp.

An assumption may have been drawn from what has been said that a resonant cavity is a fixed frequency device. While this is essentially so, unless some means are employed to alter the physical dimensions, it is still nevertheless possible to alter the operating frequency between small limits by the use of slugs, in much the same way as slugs are used to change the inductance of coils at lower frequencies. The function of these tuning slugs must be left until we have discussed the operation of waveguides, however.

More will be said too, concerning the various modes of operation possible in a resonant cavity and also the methods whereby energy may be coupled into and out of these devices.

It would take a considerable amount of space to detail all the applications of resonant cavities but such a list would include the already mentioned frequency and wavelength measurements, microwave filters, cavity-frequency converters, antenna termination, co-ax. supports, am-

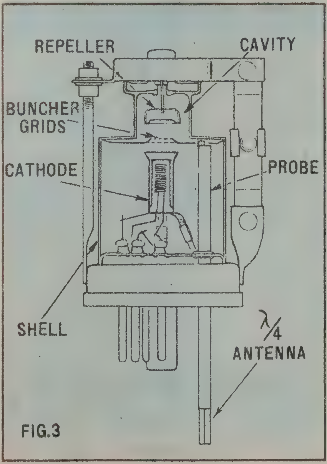
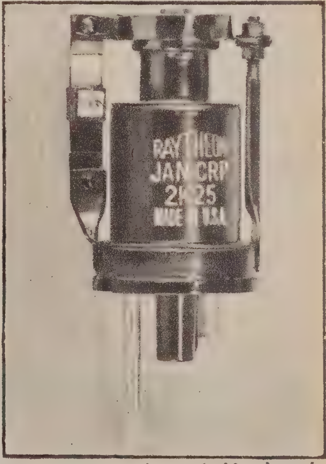


FIG.3



The reflex klystron is the most common microwave tube available through disposals sources and its internal structure is shown above left. It may be used as an oscillator for both transmitter and receiver applications, although requiring modification for amateur band use.

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Passing on now to the methods of signal generation, it may be generally stated that three main methods are normally employed.

The first method uses a special type of triode or tetrode valve in a more or less conventional oscillatory circuit, the main point of difference being the use of resonant cavities of the coaxial or waveguide type as the tank circuits. The valves employed for this type of operation are knowns as **disc-seal** or **lighthouse** valves, the active elements being brought out to concentric rings to facilitate connection into a cavity or waveguide.

The internal construction is arranged so that element spacing and internal lead inductance are reduced to a minimum. These valves find applications up to frequencies in the order of 4,000 Mcs and are capable of producing several watts of RF output with reasonable efficiency. Their use is not confined to oscillator service, many of them functioning very effectively as power amplifiers and frequency multipliers at the lower "microwave" frequencies.

The second method also employs a special valve, of which there are several varieties, and fixed or tunable cavities. These particular valves are known by the general name of **velocity-modulated** tubes, the most familiar types being the **klystron** or **reflex klystron.** More recently, a further type, known as a **travelling wave** tube has come into general use.

Ordinarily, a klystron employs two resonant cavities, either fixed or tunable, assembled as an integral part of the tube or attached externally.

The operation of a klystron as an oscillator is not difficult to grasp, although it bares little relationship to conventional oscillatory circuits.

Considering for a moment a triode amplifier valve, it will be recognised that the action of a signal applied to the control grid will be to regulate the amount or quantity of electrons passing from the cathode to the plate. The velocity of these electrons is of little importance, there just being more or less of them in the space between the control grid and the plate depending on the instantaneous effect of the voltage on the control electrode.

AMPLITUDE MODULATION

In other words, we may say that the control grid modulates the amplitude of the output signal in the plate circuit. On the other hand, the controlling element in a velocity modulated valve regulates not so much the amplitude but the relative velocity of the electron stream.

At this point, reference should be made to Fig. 2, where the internal construction of a klystron is pictured. It will be noticed that the cathode assembly is more akin to the electron gun of a cathode ray tube than an ordinary valve, the electrons being emitted in a concentrated beam of more or less constant velocity.

This electron beams passes into the area between two closely spaced grids, called buncher grids, between which is applied the input signal voltage. On reaching the first grid, the electrons pass through into the buncher space with no difficulty as the signal voltage on the first grid is in no way related to the cathode.

However, once inside, the electron stream comes under the influence of the voltage existing between the two grids and will accordingly be slowed down or speeded up, depending on the voltage condition at a given instant.

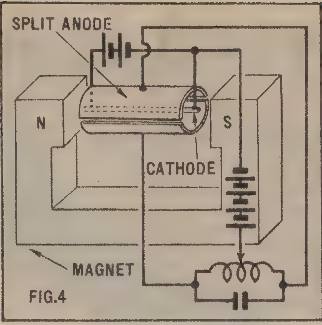

FIG.4

The magnetron is essentially a diode possessing a negative resistance characteristic due to the associated magnetic field. The above diagram shows how a tuned circuit may be connected so that oscillation is promoted.

If the second grid is positive with respect to the first, the electrons will increase their initial velocity. Conversely, if the second grid is negative with respect to the first, the electron stream will be reduced in velocity.

If an AC voltage is applied across the buncher grids, which will normally be the case of the valve is being used as an oscillator, the electron beam will be alternately speeded up or slowed down as it passes through the buncher space and out through the second grid.

ELECTRON BUNCHING

The net result of this velocity changing process is to cause the faster electrons to catch up with the slower ones which preceded them in the drift space beyond the buncher grids. At a given distance from the buncher grids large groups or bunches of electrons will be travelling together through the drift space. At further distances the faster electrons will once more have outstripped the slower ones and the electron stream will be spread more evenly.

Complete bunching will take place in the drift space at intervals corresponding to one cycle of the signal wave length. It follows, therefore, that this type of valve is only feasible at frequencies where it is possible to make the drift space equal to a physical wave length.

The point of complete bunching corresponds to a point of maximum energy and it is at this point in the valve that two further grids are inserted, known as catcher grids, to collect the energy from the electron stream in the form of a pulse, one for every cycle of complete bunching.

Each set of grids is surrounded by a cavity, resonated at the desired operating frequency. In this case, the operating frequency is determined principally by the spacing between the individual grids in each pair and also by the physical size of the resonant cavities. In many instances these dimensions are made variable so that the klystron may tune a specific band of frequencies.

Energy from the catcher cavity is coupled back to the buncher cavity via a co-ax loop where it appears as a signal voltage across the buncher grids. This voltage in turn promotes further electron bunching and thereby maintains the oscillation. An additional coupling loop in the catcher cavity transfers energy out to the external circuit.

MULTIPLIERS

Two cavity klystrons find further important applications as frequency multipliers and amplifiers. It is possible to couple energy into the buncher cavity and obtain an harmonically related output signal from the catcher cavity, which is tuned to the required harmonic.

As an amplifier, power gains in the vicinity of 30 to 40 dB are possible. Special multi-cavity klystrons have been developed, each cavity separately tuned. By stagger tuning, it has been possible to construct efficient wide-band power amplifiers which find many applications in radar and other allied services.

The most commonly available klystron is the reflex type, shown in Fig. 3, and is of most interest to amateurs for several reasons. It is normally tunable over a wide band, is easy to modulate, is easily coupled to the antenna or mixer circuit and its power requirements are usually relatively low. Its only function is that of an oscillator and it normally finds service in both transmitter and receiver local oscillator applications.

The reflex klystron possesses only one resonant cavity of the rhumbatron type and only one pair of closely spaced grids. The electrons are bunched during their travel through the drift space as described earlier but, instead of energy being collected at the catcher grids and returned through an external circuit to

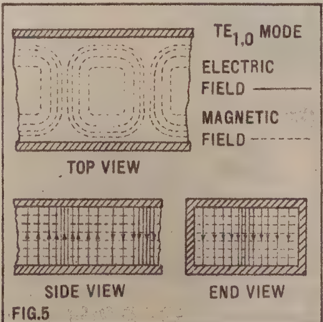

FIG.5

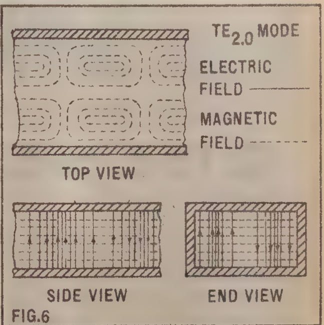

FIG.6

The above diagrams show the field distribution for two modes of energy propagation through a rectangular waveguide. Many other configurations are possible but are seldom used.

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the buncher grids, a repeller electrode is inserted at a specific distance along the drift space.

A negative voltage is applied to this electrode, the effect being to repel the electron bunches back down the drift space to the buncher grids where, providing the phasing is correct, they will provide the necessary voltage between the grids to promote further bunching.

The phase relationship of these returning electron bunches is the important factor in determining the oscillation frequency and this, in turn, is governed by three further factors: The distance over which the bunches must artvel as determined purely by the physical construction of the drift space; the initial and return velocities of the electrons which are influenced by both the beam forming voltage and the repeller voltage; the resonant frequency of the cavity around the grids, which will govern the voltage build-up between them.

CO-AX PROBE

Energy is coupled from the oscillator by a probe in the cavity which is fed out via a co-ax line and terminated in a quarter-wave antenna. The outer shell forms portion of the electron gun assembly and, as such, has a high positive potential applied. This point must be borne in mind when mounting the tube or handling during operation!

As a further example of their versatility, klystrons are not confined to microwave operation but their usefulness extends well down into the UHF region. The largest electron tube in the world is a multi-cavity klystron operating in the 400 Mc region and capable of handling a peak power output of 8 megawatts. The tube itself is eleven feet long and weighs 1700 lbs!

The third type of frequency generating device is the magnetron. This tube is essentially an oscillating diode of which there are again several varieties. Its function is fairly complex and it is normally of little interest to amateurs.

Magnetrons fall into two classes, the negative resistance type and the transit time type. A strong magnetic field is applied to the magnetron in such a manner as to have an appreciable effect on the electron flow from its cathode to the surrounding anode. In the negative resistance type, the anode is split and two different potentials applied. Current is higher at the lower potential anode which contradicts the normal pattern of Ohm's Law.

MAGNETIC FIELD

The magnetic field has a nullifying effect on the electron velocities and the electrons, travelling slower in the region of the lower potential anode, spend a longer time in its vicinity and therfore have more chance of being attracted to it. A resonant cavity is coupled to the magnetron in such a manner that its own inherent losses are overcome by this negative resistance characteristic, thereby enabling an oscillation to be maintained (Fig. 4.)

The transit time magnetron depends largely on the orbit time of the electrons to determine the operating frequency in addition to the resonant cavities. These types are less susceptible to transit time effects than are the negative resistance variety and consequently are usable at much higher frequencies.

In both types the strength of the magnetic field is critical and it is not possible to modulate them effectively under normal conditions.

Finally we must consider waveguides in a more or less general way so that we may clear the air for discussions of a practical nature next month.

A waveguide is essentially a device for conveying RF energy from one point to another in exactly the same manner as a transmission line. In fact, it would be quite true to say that all transmission lines are waveguides because of the task they accomplish.

However, we cannot consider the function of a true waveguide in the same manner as a two-wire or co-axial line, where it is a fairly simple matter to determine by measurement the current and voltage distribution along its length.

The term "waveguide," as applied to microwave operation, refers to a hollow, metal tube, either circular or rectangular in cross-section, through which energy may be passed from generator to load.

Waveguides are used at microwave frequencies for two reasons. They are usually easier to make than co-axial lines and they can be made to have less attenuation.

Energy is transported along a transmission line because of a voltage stress or electrostatic field made to exist between the two conductors and this, in conjunction with a current or magnetic field, forms a composite wave which moves along the line from the source to the load. In a waveguide energy is still transported in the form of an electromagnetic wave but the pattern or arrangement of the fields comprising the wave may take any one of many forms.

PROPOGATION MODES

These various modes of propagation are determined principally by the size/frequency relationship between the waveguide and the propagated wave and also by the method of coupling energy into the guide. Normally, either the electric or magnetic field will have no component along the length of the guide.

If the electric field is such that it lies entirely in planes across the waveguide, the magnetic lines of force will be mainly along the length of the waveguide. Such a mode is known as a transverse electric, or TE, mode of progagation.

Conversely, if the magnetic lines of force lie entirely in planes across the guide, the mode is known as a transverse magnetic, or TM, mode of propagation. Looking at the end view of a rectangular waveguide, Fig. 5, the electric lines of force are across the narrow dimension of the guide. The density of the lines indicates the relative intensity of the field while the arrow-heads indicate the polarity.

This particular case indicates that along the wider edge only one half-wave of the electric field pattern appears, or that the waveguide is just one half wavelength wide. In order to indicate this particular condition, the type of mode (in this case a TE mode) is given a subscript which indicates the number of half-waves occurring across the wider dimension of the guide. A second subscript is added which indicates the number of half-waves occurring across the narrow edge.

FUNDAMENTAL MODE

The case illustrated in Fig. 5 would correctly be called $TE_{1,0}$ mode and is often referred to as the fundamental mode. The case illustrated in Fig. 6 occurs when the wide dimension of the guide is greater than two but less than three half-wave lengths and is classed as a $TE_{2,0}$ mode. The fundamental mode is the one most commonly used in all microwave operations. It should be noted that some textbooks reverse the position of the subscripts when classifying the modes.

If the wider dimension of the waveguide is less than a half wavelength of the signal being propagated, considerable attenuation will take place due to dissipation in the side walls of the guide. The cut-off wavelength for any rectangular waveguide is 2z where "z" is the wider dimension of the waveguide in centimetres.

Theoretically, all frequencies higher than the cut-off frequency may be transmitted with little attenuation although, at wavelengths less than 1.1z, modes other than the fundamental are likely to occur. It is normal to calculate the lowest usable wavelength as being equal to 1.6z, attenuation increasing more rapidly beyond this figure.

Next month we hope to discuss further the important theory of waveguides and also to present a practical approach to the construction of an amateur station using readily available disposals equipment in the 10,000 Mc region.

Bibliography.

"Understanding Microwaves," Victor J. Young. (Rider publication). "Microwave Receivers," Radiation Laboratory Series, Vol. 23.

POWER CABLES ACROSS BOTANY BAY

THE N.S.W. Electricity Commission has let a £1 million contract for the supply and installation of three high voltage underground and submarine power cable connections across Botany Bay. The submarine section, 1¾ miles long, will be laid in open sea between the heads of Botany Bay and the underground sections buried in three feet deep trenches on either side. The cables will be operated at 132,000 volts, and each circuit will have a power capacity of 120,000 kilowatts.

The Commission has had the submarine route surveyed, and explored by skin divers, and although the main portion of the route is smooth sand, the landing positions on both sides present difficulties. On the south side there is a shelving bottom of sand studded with rock ridges, while on the north side the landing is exposed to ocean storms.

There are very few high voltage cables laid in comparable conditions, and the job will be the most difficult of its kind carried out in Australia. It will be completed in the first half of next year. With single-core, oil-filled cables for each three-phase circuit, there will actually be nine power cables laid and one spare on the submarine section; also two pilot cables.

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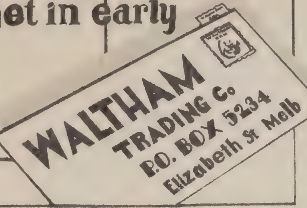

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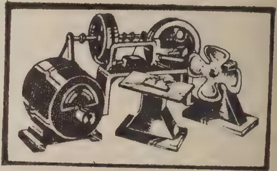

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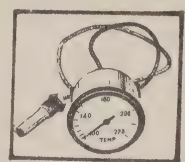

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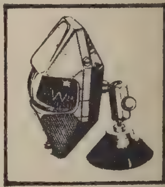

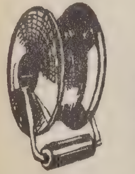

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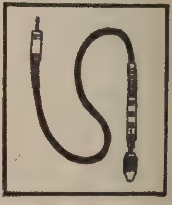

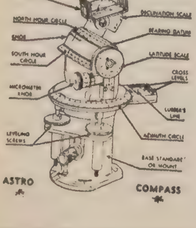

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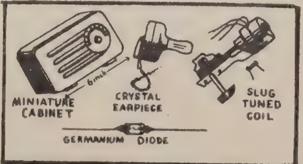

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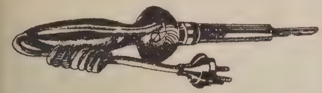

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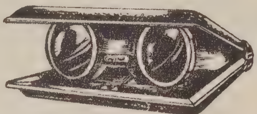

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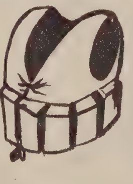

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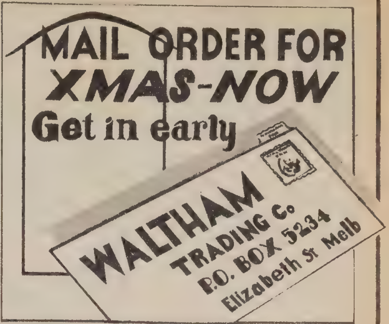

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0-30 Volt AC/DC	**55/**
0-1 Milliamp	**37/6**
0-100 Milliamp	**37/6**

(Post 2/.)

SANWA MULTIMETERS

Famous Sanwa Multimeters for checking household appliances, garage equipment, faults in car wiring, etc.

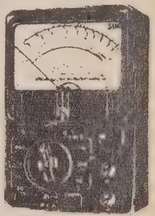
SUPER MULTIMETER

2,000 ohms per volt. All voltages from 0 to 1,000 AC/DC. Also 0 to 500 micro amps., 0 to 500 milliamps and plus and minus 20 decibels.

£5/19/6

MULTI-TESTER

Sensitivity 1,000 ohms per Volt. Checks all voltages from 0 to 1,000 AC/DC. **£3/19/6.** Both post 8/6.



VALVE BARGAINS

1A3	7/6	2V3	15/-	6F8	12/6
1A5	7/6	2X2	3/11	6G6	5/11
1B32	7/6	3A5	4/6	6H6	1/6
1D8	5/-	3B24	7/6	6J5	12/6
1F5	10/6	5T4	12/6	6J6	12/6
1G6	7/6	5W4	12/6	6J7	12/6
1H6	3/9	5X4	12/6	6K6	6/9
1J6	5/-	6A6	10/6	6K7	3/11
1K5	3/9	6AB7	10/6	6K8	6/9
1K6	7/6	6AC5	10/6	6L7	3/11
1K7	3/6	6AG5	3/9	6N7	9/6
1LN5	5/-	6AG7	12/6	6Q7	12/6
1L5	7/6	6AJ5	5/11	6R7	12/6
1P5	1/6	6B4	10/6	6SC7	12/6
1T4	3/9	6C4	3/11	6SF5	7/6
2A3	12/6	6C8	3/11	6SH7	2/3
2C26A	12/6	6F7	12/6		

Rectifiers and Transformers

Make your own battery charger with this kit. 6 and 12 Volt Rectifier and Transformers to make your own 5 amp battery charger. Circuit is supplied. **£5/12/6.**

(5/ Delivery to Rail.)

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230 Volt Primary.

6-12-18-24-32 Volt 2 amp	52/6
6-12-18-24-32 Volt 3 amp	59/6
6-12-18-24-32 Volt 6 amp	75/
230 Volt, 110 Volt, 300 Watt	£7/7/

(5/ Delivery to Rail.)

CARAVAN ELECTRIC PLUG AND SOCKET

7/6 per pair. (Post 6d.)

CUT-OFF VALVE

24 or 32 Volt cut-off valve for air or liquid. **25/.**

(Post 2/6.)

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12 and 24 Volt F 24 Camera motors. **10/.**

(Post 5/.)

THREE-GANG VARIABLE CONDENSERS

12/6. (Post 2/6.)

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Pocket hearing aid complete with lead, plug and earphones. Clips inside the pocket. **35/.** (Post 2 .)

AIRCRAFT ALTIMETERS

Ex Air Force altimeters in good condition. Reads 0 to 30,000 feet. **17/6.**

(Post 2/6.)

No. 11 VERNIER DIALS

Has normal and extra fine tuning adjustment. **9/11.**

(Post 3/6.)

ALNICO MAGNETS

Big "V" shaped alnico magnets. Extra powerful. **5/.** (Post 1/.)

VOICE POWERED HANDSETS

Standard P.M.G. replacement sets. Ideal for TV antenna installation, etc. **25/ each.** (Post 3/.)

Let's Buy An Argument

A CIRCUIT THAT CAN'T WORK

As I think I've observed on previous occasions, one of the fears which haunts a technical writer, or a magazine editor, is that they will go into print with some glaring, basic error, which can't be blamed on compositors, draughtsmen, printers or anybody else. Attitudes and speeches might be forgotten but the printed word remains for all to see and at any time they care to look.

By Neville Williams

IF you think the above introduction is a lead-in to some embarrassing confession on our part, you're mistaken—fortunately—this time.

Like anybody else we make a few "blues" but we seem, thus far, to have been fortunate in keeping them to relatively minor orders of magnitude. (Like the small boy who shot his father dead—but only with a small-calibre gun!)

No, our remark is prompted by a fully ornamented 4-page article in a contemporary American technical magazine, which was brought to our notice a few days back. It describes a method of adding AFC (automatic frequency control) to television receivers, to take over the function of fine tuning.

"BLUE" RIBBON

In fact, the article looks like being a worthy contender for the "blue" ribbon in technical journalism.

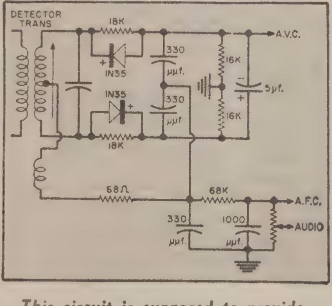
The author begins his article with a reference to the well known broad-band characteristic of television sets and an observation that "a relatively small amount of frequency change due to inaccurate tuning or drift would not seem to matter much."

He then mentions the tendency for set owners to leave the fine tune in some "average" position which may work for all channels but be optimum for none. This is particularly likely to happen, he remarks, in receivers fitted with remote control facilities.

It is thus perfectly clear that he is not talking about old-style twin IF channel systems, which demanded very accurate drift-free tuning for the sound quality to be acceptable. He can be talking only of conventional intercarrier receivers, now virtually universal in Australia and America.

From this point, he makes a case for proper fine tuning on the grounds (1) "the apparent gain in signal strength with AFC is rather remarkable," (2) "increased sharpness and reduction of noise in the picture" and (3) "enhanced quality of sound."

I go along quite easily with the bit about "increased sharpness" because that is often the main reason why a critical viewer will fiddle with the fine tuning. The other remarks about signal strength, picture noise and sound quality ar borderline statements which are as lik as not to be related to other aspects o the circuitry and alignment.



This circuit is supposed to provide the differential voltage for automatic frequency control in an ordinary TV receiver.

But they could be accepted as th claims of an enthusiast—and most of u get enthusiastic at one time or another!

But then we are greeted with th observation "Why relatively small error due to mistuning and drift should mak such a difference on a wide-band signa is a matter of speculation."

Well now, that's mighty interesting!

PASS-BAND SHAPE

More than one writer in this magazine, including your humble servant, has written articles about the pass-band shape of television receivers, optimum tuning and so on. Nor did we think of it first. We read most of it in books and copied the details from standards published by the Australian Broadcasting Control Board.

The circumstance rather reminds me of a letter which we published in these columns recently, referring to one of our own features . . . "I thought I understood Miller Effect, until I read your article on the subject!"

Either the writer of this new article on automatic frequency control hasn't read all the analyses of pass-band shape, etc., or he regards them as so much speculation.

Take your pick.

But he has an interesting theory of his own. He suggests that the evils of mistuning may stem from the RF stage, where the response may not be as broad

s is popularly supposed, particularly in
nodern tuners. He says:

"Today, high sensitivity is at a prem-
um. This means operating the RF sect-
on for higher gain, which, in turn,
neans narrowing the bandwidth. Thus,
mproper tuning can result in cutting off
nformation at one end of the band to
e received."

Well I never!

It sounds so neat and convincing but
here's one slight complication which
ou'll pardon me for mentioning.

Fine tuning, whether accomplished manually or per medium of AFC does NOT affect the peaking of the RF coupling circuits. These are adjusted when the tuner is lined up at the factory and simply switched in or out of circuit by the turret mechanism.

SCILLATOR ONLY

Fine tuning operates only on the oscil-
ator and affects the placement of car-
ier and sideband resultants, after fre-
uency conversion, in the prealigned IF
mplifier system. This is where the major
ss of definition occurs through incor-
ect tuning.

But the writer of the article in ques-
on sails blissfully on, to acknowledge
ost graciously the source of his big
lea to correct the situation. He got it
om an earlier article in the same jour-
al dealing with the problem of drift
F.M. tuners.

This earlier article explained that the
oltage at a certain point in an F.M.
etector was an effective zero when the
ner was spot-on to the signal; that
nbalance occurred when the tuning
ifted or drifted, the resultant unbal-
nce voltage being negative or positive
cording to the direction of mistuning.

Further, this voltage could be applied
certain types of semi-conductor diode
vary their junction capacitance, which
uld be used, in turn to vary oscillator
ning. By suitable manipulation of cir-
itry and constants, a large order of
tomatic frequency control could be
hieved thereby.

RACTICAL SCHEME

In itself, this idea, though relatively
w, is well founded and workable. It
n be applied to particular advantage in
M. tuners because they are subject to
me drift and mistuning producing quite
pleasant distortion.

Our present author was intrigued by
e idea.

But why limit it to F.M. tuners?

Television receivers could do with a
mple system of automatic frequency
ntrol to overcome some of the prob-
ms, as already outlined.

Television used F.M. sound, so it
ould work out exactly as for ordinary
M. tuners!

No sooner said than done. Discon-
ct the fine tune capacitor; replace it
ith a suitable diode; bias the diode so
e differential voltage from the F.M.
tector can swing it over a suitable
orking range; pick up the differential
ltage from the detector system; attend
a few other details; you're in business.

And, man, oh man, does it work!

But excuse me . . .

Just look at this: Switch it from chan-
l to channel and note how good the
cture is!

But, wait a minute . . .

Man, will you look at that picture!
hy didn't the boffins think of this one?
Because . . .

It just goes to show you, doesn't it?

I won't go on with this imaginary conversation, lest you find it even harder to read than it is to write.

The fact of the matter is that the situation with television is completely different from ordinary F.M. broadcasting.

Since virtually all television receivers nowadays are of the inter-carrier type, the frequency of the

THE MISSING STATIONS MYSTERY

Dear Sir,

I think this note should be passed on to the Sherlock Holmes' department, as the problem strikes me as a very knotty one.

It started when a certain young party suggested I build him a crystal set. In a roundabout way I secured an August, 1954, copy of your magazine, in which was set out a de-luxe dual-coil crystal receiver.

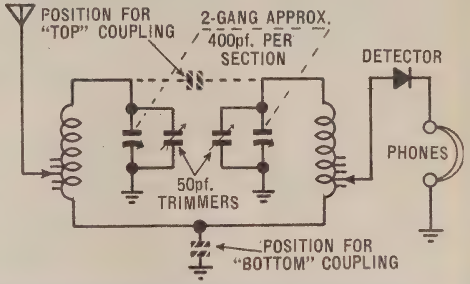
All went well until it was put to a practical test. Volume was passable and it did seem to eliminate all but the frequency desired, but a "count down" of stations revealed a mystery.

When I get 4QR (Brisbane) it is near impossible to receive 4BK, let alone 4BH. Then I found that, by turning the aerial trimmer, I can bring 4BH into the picture, but, alas, 4QR is entirely eliminated.

Must I always have a screwdriver in hand when I go near the darned thing? Isn't there some short-cut method that can be adopted so one can get the complete range of frequencies available here in Brisbane?

Yours faithfully,

A.D.



BRIGHT STAR CRYSTALS

FOR ACCURACY, STABILITY, ACTIVITY AND OUTPUT

Our crystals cover all types and frequencies in common use and include overtone plated and vacuum mounted. Holders include the following: DC11., F.T. 243., H.C.—6U., CRA., B7G., OCTAL, HC-18U.

5.5 KCS. TV Sweep Generator Crystals.
£3/12/6 plus 12½ p.c. sales tax.
100 KCS and 1000 KCS. Frequencies Standard.
Crystals £8/10/ each plus 12½ per cent sales tax.

AUDIO ULTRASONIC AND SPECIAL CRYSTALS
PRICES ON APPLICATION.

The following fishing craft frequencies are available in F.T. 243 holders:
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Immediate delivery available for all above types.

AMATEUR TYPE CRYSTAL 3.5 and 7 MC BAND
Commercials — from £3/12/6 each plus 12½ per cent sales tax.
Amateur — from £3/-/- each plus 12½ per cent sales tax.
Regrinds £1/10/-.
Crystals for Taxi and Bush Fire Sets also Available.
We would be very happy to advise and quote.

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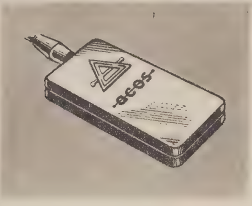
WITH THE CO-OPERATION OF OUR OVERSEAS ASSOCIATES OUR CRYSTAL MANUFACTURING METHODS ARE THE LATEST.

ACOS CRYSTAL MICROPHONES AND MICROPHONE STAND

LAPEL
TYPE 28

Designed to give freedom of movement, this microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel. PRICE: £5/19/6.

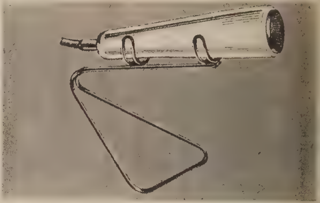


STRINGED INSTRUMENT
TYPE VP1

Specially designed for use with guitars, double bass and, in fact, all stringed instruments. With the use of this simple yet effective pick-up together with a good-quality amplifier, any instrument can be amplified. The VP1 has ample output and a frequency range which extends to approximately 6 K/cs. PRICE: £7/15/-.

DESK TYPE
MIC 40

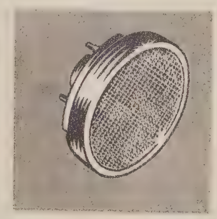
Pleasantly styled in two-tone colour to give a handsome, quality microphone of modest dimensions and unassuming price. Ideal for tape recorders with a minimum of stowage space available. £3/19/6.



STICK TYPE
MIC 39

The MIC 39-1 has been beautifully styled as a hand, desk or floor stand unit, and precision engineered to the highest professional standards. A heavy diecast liner in the microphone case eliminates the possibility of hum pick-up due to hand capacity effects. The use of a special noise-free cable improves screening and gives a greatly increased signal-to-noise ratio. PRICE: £7/19/6.

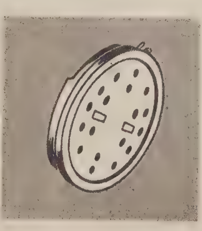
MICROPHONE INSERTS



TYPE MIC 38

Omni-directional frequency response	40-10,000 C.P.S.
Sensitivity	—62 dB ref. 1 volt/dyne/cm² (approx. 1mV)
Load resistance	5 megohms
Effective capacity	880 pF
Maximum diameter	1.125"
Minimum diameter	0.75"

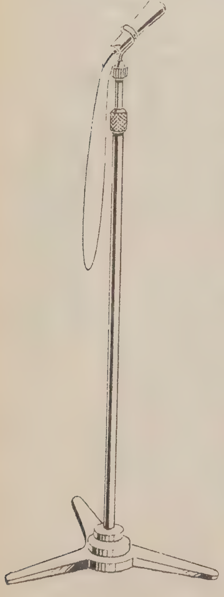
PRICE: £4/19/6



TYPE MIC 43

Output level	—50 dB ref. 1 volt/dyne/cm² (approx. 3mV)
Capacity	800 pF approximately
Omni-directional frequency response substantially flat	40-6,000 c.p.s.
Recommended load	Not less than 4.7 megohms
Maximum diameter	1.75"
Minimum diameter	1.5"

PRICE: £2/15/6.



FLOOR MICROPHONE STAND

(Shown fitted with MIC 39 and adaptors)
Price: Stand, £5/6/-. Adaptor, £1/15/-. The base and lower tube are finished in silver varitone finish, the extension arm is chrome-plated.
DIMENSIONS: Base diameter, 17 inches. Height, min. 3 foot 3 inches; max. 5 foot, 6 inches. Weight, 11 pounds.

AMPLION (A/SIA) PTY. LTD.

29 Major's Bay Road, Concord
Sydney, N.S.W. Phone 73-1227

signal applied to the F.M. detector is ENTIRELY dependent on the difference frequency between the two carriers broadcast by the television station. The frequency is NOT affected by tuning. There is therefore, NO differential voltage available to operate an A.F.C. system in the manner described. The article is based on a completely false assumption.

But still the author goes on undaunted. Having described in detail the necessary nodification to a typical tuner, he outines the setting-up procedure. This involves monitoring the output from the atio detector with a centre zero VTVM, while varying the receiver tuning on hannel 13.

He says, "By rocking the slug, you hould be able to swing the reading beween a minimum of 2.5 to 3 volts positive, and 2.5 to 3 volts negative . . . In any case, the positive and negative swings should be of equal maximum amplitude."

Pardon me while I gape.

IT CAN'T HAPPEN

What he describes in such detail shouldn't happen, and it doesn't happen and it can't happen.

Then, by what system of black magic was the contributor able to state that it did, to quote typical voltages and to use the voltages for his particular purpose?

Did he measure at the actual point designated, or was the voltage tangled up with the diode bias at the time of measurement? Did he do the test on an actual television station or with a signal generator which gave him a beat across the sound channel frequency? Did he derive figures from an F.M. tuner and merely assume that they would be the same from a television set?

Your guess is as good as mine.

Last but not least, if the system worked at all, as it was claimed, and if it couldn't work on a non-existent differential voltage, then what actually did go on?

I can only guess that by pure accident, it approximated a method of frequency control which is legitimate and which is used. This involves deriving a voltage from the F.M. detector, from an unbalanced point, where the voltage is of suitable polarity and proportional to the AMPLITUDE of the intercarrier sound signal.

This voltage is applied to a semi-conductor capacitive diode, as before, in uch a way as to allow the sound carrier o climb a limited way up the back of the IF response curve. By having the curve the right shape, by not limiting too much the sound signal reaching the ratio detector and by having everything else just right, it can be used for automatic frequency control.

Perhaps the system suggested in the article approximated this by accident, relying on some UNBALANCE rather than otherwise for a small voltage from the ratio detector. As I said before—or did I?—your guess is as good as mine.

I'm only glad the article didn't sneak into this magazine, leaving me to justify its inclusion!

★ ★ ★

While in a mood for mysteries, a reader from Brisbane submits a problem which he personally finds quite baffling. Others, more experienced in the art, may dismiss it as "simply a matter of tracking" but let's treat it for what it is to our correspondent—a real problem.

Why not read the letter now?

In case you're not quite au fait with what it is all about, we have reproduced the circuit of the receiver in question, along with the correspondent's letter.

Basically, it consists of two coils, each with tappings toward the earthy end. The aerial is connected into one via a selected tapping, while the detector-earphone circuit is connected to the other, also via a selected tapping. The coils are tuned by the respective sections of a two-gang capacitor, with trimmers across each for adjustment purposes.

INDUCTIVE COUPLING

In the original receiver, signal was transferred from one coil to the other by inductive coupling, the two being mounted on opposite sides of the not-too-large tuning capacitor. It was suggested, however, that where sufficient coupling could not be obtained by these means it could be secured by a capacitor of about 4.7pf across the active ends of the coil ("top" coupling) or a capacitor of about .05mfd in the common earth return lead ("bottom" coupling).

In the description of the receiver, we made a particular point about the coils having to be wound to exactly the same specifications—the same gauge of wire, the same former, exactly the same number of turns and tapped in the same manner.

Now if two identical coils are tuned by two identical gang sections, it follows that they will always be resonant at the same frequency, no matter where the plates of the gang happened to be set. Assuming that specifications are right for the present purpose they will remain in step from about 550Kc. with the gang plates almost closed, to about 1600Kc. with the gang plates almost open.

In other words, the tuned circuits will "track" across the entire broadcast band.

In practice, such an ideal situation is difficult to achieve. Slight variations in wire spacing and tension, differences in the placement of the coils relative to other metal objects and even inaccuracies in the gang capacitor itself modify the exact resonant frequency, so that the individual coil/capacitor combinations tune to slightly different frequencies.

EXTERNAL WIRING

In addition, connection of external wiring, such as from the aerial and the detector, further affects the resonant frequency. Thus, when two or more slightly mistuned circuits are used in a receiver to select an incoming signal, they cannot do it accurately or to best advantage, resulting in a loss of signal and of selectivity.

As a first approach to this problem, it is normal to place small "trimmer" capacitors in parallel with each section of the tuning gang. With the receiver tuned to a station near the high frequency end of the band, the trimmers are adjusted for maximum signal level, indicating that the respective circuits have been brought to the same resonant frequency as the desired incoming signal.

In a receiver like the one under discussion, where both circuits are likely to have about the same order of selectivity, it sometimes helps to rock the dial back

(Continued on Page 109)

R. H. Oxford & Son

NEW R.T.V. & H.
CHASSIS & PANEL
VALVE & TRANSISTOR TESTER

Nov., 1960
Case brackets and printed panel **£5/2/6**
Plus 12½% Tax.
Case, brackets and engraved multi-colour panel **£7**
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5.5 & 36 Mc SWEEP GENERATOR

March, 1961
Case, chassis, printed panel, **£3/4/6**
Case, chassis, engraved multi-colour panel .. **£4/19/6**
Plus 12½% Tax.

PLAYMASTER No. 10

May, 1960
Chassis and printed panel .. **£2/19/6**
Plus 25% tax.
Engraved panel (red or brown figures) **£2**, plus 25% tax.

MULLARD "OUTLOOK"

Tuner unit, metal work .. **£3/4/9**
Plus 25% Tax

THE "OXFORD" CASES

MC4—7 x 4 x 4		10	0
MC62—6 x 6 x 2½	1	0	0
MC6—6 x 6 x 6	1	0	0
MC6L—6 x 6 x 6 with louvres	1	2	0
MC7—10 x 8 x 7	1	5	0
MC81—10 x 10 x 8	1	13	0
MC811—12 x 11 x 8	2	2	6
MC79—15 x 9 x 7	2	12	6
MC5A—9 x 6 7/8 x 5½ ..	1	5	0
Chassis Al.		16	6
MC82A—13 x 8 x 6 7/8	2	2	6
Chassis Al.	1	4	6
MC87A—15 x 10 x 8 ..	2	12	6
Chassis Al.	1	7	6
MC67—12 x 7 x 6	1	7	6

All parts 12½% tax.

AGENTS:

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T. H. HILL,
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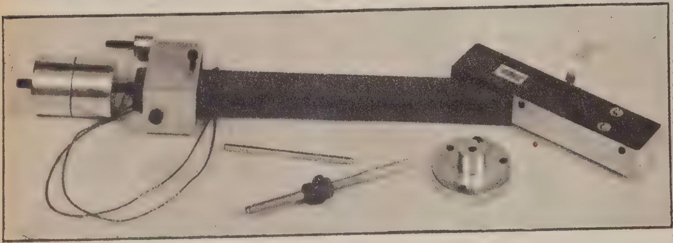
Manufactured by:

HEATING SYSTEMS
PTY. LTD.
97 Marriott St., Redfern,
Sydney. 69-3764, 69-3829,

TRADE REVIEWS AND RELEASES

AUST. MADE WOODEN PICKUP ARM



As distinct from the very complex and often expensive pickup arms being imported from overseas, the locally made "J.H. Transcription Arm" is of interest both by reason of its simplicity and the fact that it is of predominantly wooden construction.

THE manufacturers set considerable store by this latter feature, claiming that wood has natural damping qualities which tend to inhibit modes of vibration in the arm, which can affect the quality of the reproduced sound. While others contest this general claim, it is nevertheless true that some metal arms use wood inserts, while some very highly priced professional arms are also made of wood.

The J.H. arm is finished a dull black, surface-treated to resist marking. It swings horizontally on a single pivot point, while two opposing pivots take care of vertical movement. Needless to say, movement in both directions is substantially free from drag.

Two counterweights on a threaded extension serve to balance the weight of the head, while a side weight and the overhang from the front end of the arm provide some balance for the offset head in the longitudinal mode. It is intended that playing weight be imposed by a small leaf spring and screw arrangement within the pivot box.

To offset the torque produced by the drag of the groove on the stylus, the manufacturers suggest the rather novel though "finicky" course of "dressing" critically the leads which pass down through the motor board.

On test, there was no difficulty in maintaining 100 per cent tracking with a typical good quality magnetic cartridge, at a playing weight of 2 grams. Under optimum conditions, the manufacturers claim better than 1 gram. There is plenty of room in the head area, by the way, to accommodate likely types of cartridge. J.H. Reproducers, 10a Pine Avenue, Elwood, S3, Victoria. XA4583. Retail price quoted as £15.)

DE HAVILLAND P.A. AMPLIFIERS

WELL known for their technical achievements in the field of aircraft and missiles, the De Havilland Co. are now extending their activities into the field of transistorised electronic equipment.

Two of their recent releases are the 10-watt portable public address amplifier and the personal public address amplifier illustrated at right. Both units are quite interesting and proved to perform well under test.

De Havilland

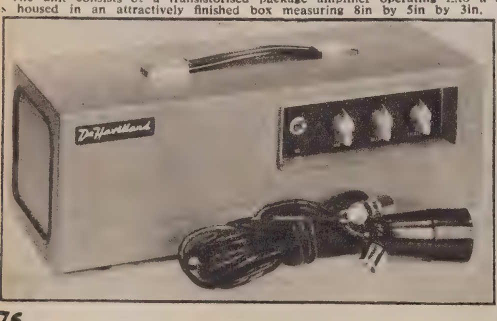
The larger unit would have many applications and is well suited for outdoor functions such as sporting events, etc. Power for this unit is supplied by four self-contained lantern batteries which give a continuous duty life cycle of 40 hours. Where long periods of operation are envisaged, an AC power supply, which slides into the battery compartment, is available.

There are facilities for both gramophone and microphone inputs and a transistorised broadcast tuner can be supplied as an ancillary unit where required. All input and output connections and controls are mounted on recessed panels to provide protection in rugged applications.

Up to five 8in loudspeakers can be driven from the unit at one time and an inbuilt speaker with on/off switch provides monitoring facilities.

The smaller "personal" public address amplifier has been designed to cater for the needs of such people as lecturers, demonstrators, cashiers and others requiring a low-powered fixed speaker unit, sufficient to save them the strain of continually raising their voice.

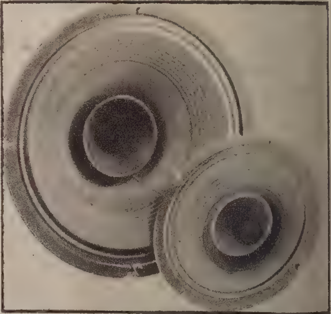
The unit consists of a transistorised package amplifier operating into a five-inch loudspeaker and is housed in an attractively finished box measuring 8in by 5in by 3in. A clip-on strap enables the unit to be slung around the neck of the operator and used with a microphone mounted on a chrome flexible conduit which plugs into a connector on the top of the box. Power output is one watt.



Price of the 10-watt unit is £41/1/5 plus tax while the smaller unit sells for £19/11/11 plus tax. Further inquiries should be directed to De Havilland Aircraft Pty. Ltd., of Burnie Avenue, Lidcombe, N.S.W., or to local agents in all capital cities.

Magnavox Mark III Loudspeakers

The Magnavox Company have recently announced the release of two loudspeakers aimed at the medium priced, high fidelity market. Developed from earlier well-known models, these two are designated respectively as 12WR Mark III, and 8WR Mark III.



IN both units, the voice coil is longer than is usual in speakers of this type, with a view to reducing distortion and intermodulation effects in the presence of high amplitude bass excitation. Loss of sensitivity, which could be expected from the longer voice coil, is countered by the provision of a magnet structure providing a flux density of 11,500 gauss.

The 12-inch speaker is credited by the manufacturers with a frequency response from 40 to 11,000 cps, with a deviation not greater than plus or minus 5 db. Power handling capacity is 10 watts maximum.

For the 8-inch, the frequency is quoted as 45 to 10,000 cps, plus or minus 6 db, with a power handling capacity of 7 watts maximum. Power figures assume appropriate baffling arrangements—a subject on which the Magnavox Company is able to advise.

Both speakers have a fundamental cone resonance in the region of 45 cps. Retail price of the 12WR Mark III is £7/10/, and for the 8WR Mark III, £7.

The speakers are normally supplied with 2.7-ohm voice coils but 15-ohm versions are available at no extra cost. For a small extra charge, and to order, voice coil impedances can be provided up to 800 ohms.

Time has not been available, to date, for a protracted listening test of the 8-inch speaker, but the 12-inch version, mounted in a conventional vented enclosure gave an excellent account of itself, both in terms of resolution and response, and certainly represents good value for the modest purchase price.

Supplies of both speakers are available through trade houses. The manufacturers are Magnavox (Australia) Pty. Ltd., 6-8 O'Riordan Street, Alexandria, N.S.W.

400mW. ZENER DIODES

A BRAND new line of 400mW rated Glass Zener Diodes by International Rectifier Corporation is announced by Warburton Franki. These feature low voltage values (3.3-12 volts), extremely low dynamic impedance (to 5 ohms) and low temperature co-efficient (minus 0.062 to plus 0.060 per cent C).

Designated types IN 746—IN 759 and IN 746A—IN759A the new devices are available in both 5 per cent and 10 per cent voltage tolerance types and meet JEDEC registered values of reverse leakage current measured at minus 1 volt.

The new diodes are process selected to provide exceptionally sharp zener characteristics and high stability and excellent voltage regulation is assured over the temperature range from minus 55 deg. C. to plus 150 deg. C.

Extremely small size (0.265in x 0.110in dia.) and glass-to-metal hermetic sealing ensure a rugged unit capable of long-term reliability. Full details are available from Warburton Franki's offices in Brisbane, Sydney, Melbourne and Adelaide.

NEW DOUBLE BEAM C.R.O. FROM COSSOR

Recently released on the Australian market by Messrs Jacoby Mitchell and Co., is model 1091 split beam oscilloscope manufactured by Cossor Instruments Ltd. of England. Designed to provide the maximum number of facilities at the minimum of cost, the unit has many features normally found only on more expensive instruments.

THE tube used is Cossor's own 4in split-beam P.D.A. type 93D, which has a flat screen with green fluorescence and medium persistence. A Mumetal shield is fitted.

One of the main features of the instrument is the comprehensive time base fitted. This has 21 basic calibrated sweep speeds from one microsecond/cm to 5sec/cm and all ranges can be expanded by five times, giving a maximum calibrated sweep speed of 0.2 microsecond/cm. In addition, continuously variable sweeps are available with repetition rates from 0.25 c/s to 200 Kc/s. Operation can be triggered or repetitive, synchronised from plus or minus signals derived from the Y amplifier or externally.

The two Y amplifiers are identical and have a response of DC to 3Mc/s with a rise time better than 0.12 microseconds and negligible overshoot. Compensated attenuators give sensitivities of 50V/cm, 15V/cm, 5V/cm, 1.5V/cm and 0.5V/cm. Input impedance is 1 megohm, 60pF to 3 megohms, 30pF, depending on attenuator setting.

A pre-amplifier which switches in automatically on the Y1 channel gives sensitivities of 150mV/cm, 15mV/cm and 5mV/cm at a reduced frequency response of 5c/s to 500Kc/s and an input impedance of 1 megohm, 20pF.

General appearance and layout of controls, etc., are both pleasing and functional and checks in our laboratory indicated that manufacturer's claims are justified. The price of the unit is £132/10/ plus sales tax which is very reasonable for a double beam instrument such as this. Further inquiries should be directed to the agents, Messrs Jacoby Mitchell Pty. Ltd., of 469 Kent Street, Sydney. (K.W.J.)

SERVO AMPLIFIERS FROM AWA

A NEW range of instrument servo amplifiers, manufactured in America by Industrial Control Company, is available in Australia from Amalgamated Wireless (Australasia) Limited Engineering Products Division. They are recommended for high performance positional and velocity servo loops in industrial and military applications.

Four types are available, all designed to operate in a servo loop where the mechanical requirements are met with a size 18 servo motor. The output stage is identical in all four types but the input circuits are designed for different requirements. One type will accept single speed A.C. data, another two-speed synchro data and the remaining two D.C. input signals.

These amplifiers follow the modern trend of standardised plug-in units which can be removed for servicing and replaced by another unit of identical design with minimum interruption to the service. The units measure only 8in x 4in x 3in and weigh under 2¼lb.

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M8 Ribbon Microphone 35-13,000 CPS in pleasing satin chrome finish with 4-inch flexible arm for hand or stand mounting.

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Salt shaker 35-12,000 CPS.
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AMERICAN MICROPHONE COMPANY.

Model D204, 80-8000 CPS.
Dynamic finish chromeplate.

Model D22.
Dynamic omni-directional pencil 50-15,000 CPS finish gold and black.

Model D44/W52.
Dynamic omni-directional boom microphone 50-15,000 CPS with exclusive windscreen. Finish, satin and black.

Model DR330.
Dynamic cardioid and ribbon variable polar pattern 40-15,000 CPS finish gold and black.
Other models available on request.

FROM WEST GERMANY SCHALL-TECHNIK.

Designed by the well-known Dr Ing K. Schoeps who over many years has supplied a large range of microphones to major European microphone manufacturers.

Model MK240.
Condenser cardioid, pre-amplifier and power supply with windscreen. Acoustically built to counteract feed-back, 100 to 15,000 CPS. 30 db front to back ratio.

Model M934B.
Condenser variable polar pattern, pre-amplifier and power supply with windscreen, 30-15,000 CPS within 4 db. 360 degree pattern. In cardioid pattern 30-15,000 CPS. 30 db front to back ratio.

Model CM64.
Condenser, variable polar pattern, pre-amplifier and power supply with windscreen. 30-15,000 CPS within 3 db. 360 degree pattern. In cardioid pattern 30-15,000 CPS. 35 db front to back ratio.

Model CM65.
as CM64 but with 360 degrees pattern is only, 2db from 40-3000 CPS rising 3 db 7500 CPS then dropping 4 db to 15,000 CPS. Other models available on request.

FROM DENMARK, COFERRO.

Model RD32.
Dynamic, cardioid pattern. Frequency response 60-18,000 CPS — 55 db 1.8MV.

Model E12.
Condenser with pre-amplifier, 20-20,000 CPS —- 33 db, size 13-16in x 3in.

Other models available on request.

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ER58 Shoulder type with Separate Microphone, **£39/3/3,** plus Sales Tax 12½%.

For GOODMAN Loudspeaker Sales and Service

Contact Warburton Franki—the Victorian Service Agents. Full Stocks always available.

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AXIOM 112. Similar to above but power output 12 Watts. **Price £15/12/6.**
AXIETTE 11 8in. Speaker Frequency Range 40-15,000 C.P.S. Power 6 Watt. Fundamental Resonance 65 C.P.S. V.C. Impedance 15 ohms. **Price £15/5/-.**
Other stock types include: The Axiom 300 12in. Full range. **Price £27/18/6.**
The Axiom 350 12in. Full range. **Price £36/12/6.**
The Triaxiom 212 12in. Full range. **Price £38/10/-.**

Write or Call for Descriptive Leaflets on all the above types.

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100 mfd. 400V. Peak metal Cased Capacitors	15/	each
200 mfd. 400V. Peak Metal Cased Capacitors	19/11	each
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Type DM13 Hi-Impedance — Dynamic — Beautiful turned metal pencil type with built in switch. 8in long plus swivel unit which contains the switch. Supplied with Cord and Plug and will fit normal stands. **£11/10/.** Plus Pack and Post 3/6.

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6.3V at 2A.
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39/11 each plus
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180 m.a. 400V. A. Side
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6.3V. at 4A. C.T.
6.3V. at 3A. C.T.
5V. at 3A
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KEW MULTIMETER TK70B

Sensitivity—D.C. 20,000 ohms. volt. A.C. 9,000 ohms. volt.
Volts — A.C./D.C. 0-10, 0-50, 0-250, 0-500, 0-1,000.
Milli-amps D.C.—0-500 ua. 0-10 m.a. 0-250 m.a.
Resistance — 0-20K ohm. 0-200K ohm. 0-2 megohm. D.B. (up to 6,000 cycles) to 22 D.B.
Capacitance — .001 to .2 mfd. **Size:** 5⅛ x 3½ x 1⅞in.

PRICE — £7/12/. Plus 12½ per cent Sales Tax.

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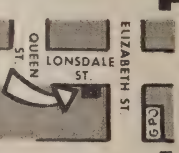

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TECHNICAL BOOK REVIEW

TEREOPHONIC SOUND, by Norman H. Crowhurst, M.I.R.E., M.I.E.E. Published by John F. Rider, Inc., 116 West 14th Street, New York. Soft cover, 136 pages, 5½ by 8½ inches.

The author of this book is an inter-tionally famous authority in the audio eld and is thus well qualified to write book of this nature. The first edition this informative volume, written in e pioneer days of stereo, proved to an accurate assessment of stereo up that date, as well as a good forecast things to come.

This second edition, published some ur years later, gives proper place to e more recent developments in the rious media of radio, disc and tape. omprehensive information has been cluded on the 45/45 disc, the now cepted standard, while typical stereo pe and playback units are thoroughly scussed.

One entirely new chapter helps the ader to evaluate for himself the con-cting claims of component perform-nce. It also explains the possibilities d pitfalls of conversion to stereo and ables him to select a system best ited to his individual listening needs.

This book is profusely illustrated with otographs, explanatory drawings and aphs which all assist in the further nderstanding of this most interesting ase of electronics.

Our copy direct from the publishers. o Australian price is given, but the ok should be available in due course.

* * *

UNDAMENTALS OF UHF, by Allan Lytel. Soft cover, 160 pages, 6in by 9in. Published by John F. Rider, Inc., 116 West 14th Street, New York, NY.

Frankly we can not recommend this ok because (a) We feel that the ex-anations of the various fundamentals e far from lucid, and

(b) the number of typographical rors, and, in our opinion, some rather or usage of the English language, ads us to the belief that the book was adequately proofread. For the record e various chapters are as follows:

1. Principles of UHF; 2. Propaga-on; 3. Transmission Lines; 4. Reson-t Lines; 5. UHF Oscillators; 6. Trans-itters; 7. Amplifiers and Receivers; Antennas; 9. Microwaves; 10. Com-unication and Television; 11. Test quipment . . . three-page index.

Our copy came direct from the pub-sher but supplies should shortly be ailable from local booksellers. KWJ.

* * *

ASIC MATHEMATICS, volume 2, by Norman H. Crowhurst. Soft cover, 144 pages, 6 by 9 inches. Published by John F. Rider, Inc., 116 West 14th Street, New York.

This is the second volume of a four lume course on Basic Mathematics at makes learning and understanding athematics, from counting to calculus, easy as learning to walk. Using a ique approach that eliminates the ythical mystery of mathematics, this lume takes the reader through simple, multaneous and quadratic equations; wers and roots, imaginary numbers; simple mechanics, including resonance; proportion and ratio, simple trigonometry calculations and properties of triangles and circles.

The course uses the "pictured-text" technique, the principle of which is that each page covers one complete idea. On each page at least one big, clear "teaching picture" drawing illustrates the idea presented. At the end of each section, questions and problems highlight the important points covered and help the reader develop his powers of application.

To those who learned mathematics the hard way it will appear that many things in this book have been rearranged into what may seem an unconventional sequence. However, this rearrangement avoids the common feeling that one is learning a great many separate and unrelated subjects. Instead, it introduces a continuity and consistency that builds a clear pattern of mathematical principles in the mind. The confusion and uncertainty that so often result from more conventional methods completely disappears.

Our copy came direct from the publisher but copies should be available from local booksellers in due course. KWJ.

* * *

ABC's OF MODEL RADIO CONTROL by Allan Lytel. Soft cover, 96 pages 8½in by 5½in containing many photographic and diagramatic illustrations in addition to the text. Published by Howard W. Sams and Co. Inc., of New York.

This book should prove to be of much interest to the avid model builder who is contemplating the radio control of his models. It does much to remove the mystery surrounding many of the facets of this portion of the art. It does not, however, give any practical details for the construction of radio control receivers or transmitters and in this sense is a little disappointing.

The book starts out with a basic explanation of radio-control systems and how they work, and shows the reader how to get started in this fascinating hobby. It then sets out to describe commercially available kits and how to select the most suitable for various purposes. However, as these are American kits and, in most cases, not available to the Australian reader, there is little value in this section.

Individual chapters are devoted to using radio control, including discussions of simple and compound control systems; fundamentals of radio; coders and transmitters, including pulse and tone codes, transmitter antennas, etc.; receivers and decoders, covering receiver functions, types and antennas, and decoding and radio repairs; motors and power control; a discussion of the local (American) licensing provisions.

The author, who has been a model builder for many years, speaks not only from this experience, but also from a background in electronics. This combination of abilities has resulted in a coverage of a technical subject that any layman can understand.

Our copy came direct from the publishers. KWJ.

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ROLA REVERB. UNIT AVAILABLE

Those who may wish to experiment actively with reverberation, in connection with domestic amplifier systems, electronic musical instruments, etc., will now be able to indulge their fancy. As mentioned in an advertisement elsewhere in the issue, the Rola Company have announced the general release through Australian trade suppliers of the Hammond type reverberation unit.

By Neville Williams

WE would very much like to have accompanied the announcement with a series of circuit arrangements, originated in our own laboratory, along with first-hand reactions to the end result.

As matters stand, however, so much is currently in hand in our laboratory that it has proved quite impossible to do so and we must be content, for the time being, merely to announce availability of the unit and to reprint the initial application data issued by the Rola Company. Fortunately, this should be enough to get any technically informed enthusiast started.

Ultimately, we have ideas of marrying the unit to our Stereo Playmaster equipment such that it can utilise one channel for the "reverberated" sound. With a bit of luck, it may be possible to adapt the present switching and balance control system to achieve the results required.

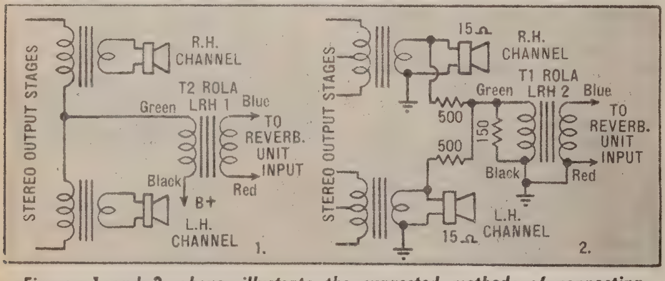
As to whether the results will be deemed worthwhile or not, only time will tell. I imagine that quite a few radiogram manufacturers would like to know beforehand what the reaction of the Australian public will be to "reverbograms!"

One thing can be said, however. The Hammond unit itself works very well, having been proved in other fields. And even if its application to radiograms should prove short-lived, there is little doubt that it will find increasing use in this country with amplifier systems associated with musical instruments.

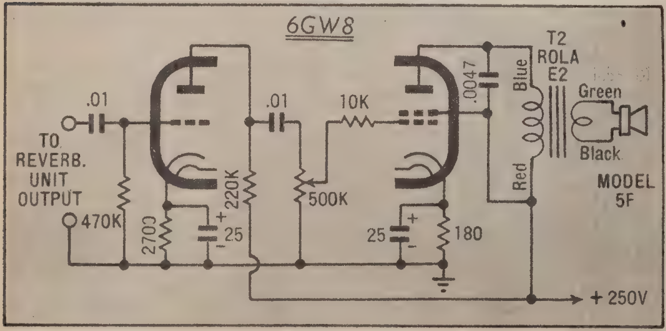
Having said this by way of preliminary remark, we can now proceed to reprint application data, issued by the Rola Company relevant to the Hammond reverberation unit.

This reverberation unit consists of two metal springs both ends of which are connected to small ferrite rotors which rotate in the field of an electromechanical transducer which functions in the same manner as a dynamic pickup.

A portion of the sound from a monaural system, or the combined sound from the two channels of a stereo system is fed to the reverberation unit. The current through the transducers causes the ferrite rotors at the input of the reverberation unit to rotate. This movement is proportional to the current through the input transducers and imparts a twisting motion to the coils.



Figures 1 and 2, above, illustrate the suggested methods of connecting single-ended and push-pull stereo systems to the input of the reverberation unit. Figure 3, below, is the circuit diagram of a simple amplifier for use with the reverberation loudspeaker.



This motion, after the delay due to mechanical inertia, is reproduced by the output transducers which generate the delayed signal which, when fed through an amplifier and loud-speaker system, contributes the echo or reverberation effect to the reproduced sound.

The delay line springs have differen delay times — 29 and 37 milliseconds respectively. This is to ensure a mismatch which will provide a series of reflections each having an amplitude which will decrease with time. This reflected energy travels through the coils to the input transducer and after additional reflection again reaches the outpu end.

The process is repeated several times the result of the repeated and overlapping reflections being a multitude o signals having different amplitudes and delay times. In this way the natura reverberation effect occurring in a concert hall performance is simulated with a remarkable degree of fidelity.

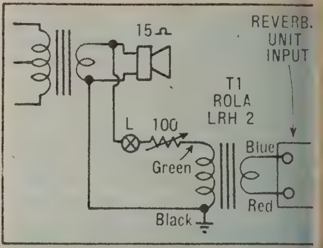


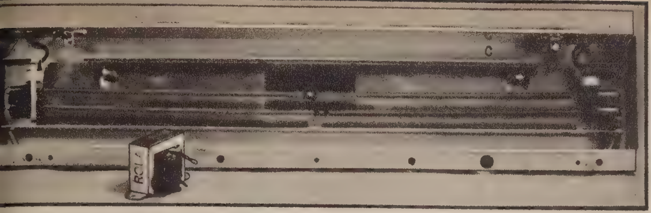
Figure 4 shows the method of connecting the reverb. unit to a push-pull output monophonic system. The same method may be used if the amplifier output is single-ended.

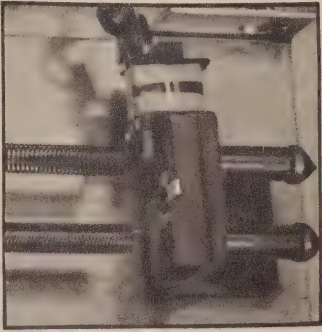
The signal applied to the reverberation unit must be monophonic. This poses no problem in a single channel amplifier bu for use with stereo systems it is necessary to combine the Right and Left hand channel signals. There are several way of doing this but that shown in Figs. and 2 is probably the simplest and mos effective.

Fig. 1 shows the output stage of a single-ended stereo amplifier connected to a matching transformer the secondary of which feeds the input transducer of the reverberation unit. Fig. 2 shows the circuitry required when the stereo amplifiers have push-pull output stages.

A more elaborate system isolates the channels before combining them fo monophonic drive and feeds the reverberated signal into both channels, retaining the original two channel system.

Fig. 3 shows the suggested amplifie for use with the separate reverberation speaker. Control of the amount of reverberation is provided by the potentiometer in the reverberation amplifier. Th





A view of the reverberation unit and, below, a close-up of one of the rotary transducers. Transducers and springs are on a sub-plate which floats inside the box on small springs. The unit is surprisingly non-microphonic.

verberation speaker should be centrally cated between the two stereo speakers a two channel system.

Figure 4 shows the suggested method connecting the reverberation unit to a gh powered monaural output stage. L a 12 volt globe which, in conjunction th the 100 ohm variable resistor, is ed to limit the input to the reverberan unit. The resistor is adjusted until e lamp glows when the signal level es to the point where overload starts.

It should be emphasised that freencies below 200 and above 4,000 cles per second do not contribute anying to the reverberation effect and for is reason reverberation units are ually designed to cut off at these freencies.

In using the reverberation unit there e a few points to keep in mind. sually, program material such as vocal d solo instrumental numbers require s reverberation than a full orchestran. Also, some recordings have more herent reverberation than others.

Remember, too, that less artificial verberation is required at high volume vels than at low levels because, when e level approaches that of the original rformance, the room itself contributes rgely to the reverberant effect. The verberation control should be used milarly to the volume and tone controls with discretion.

One important additional application for a reverberation unit is in connection with tape recording. Very rarely will the recording hobbyist have access to a studio, nor will he be likely to encounter good acoustical conditions in his home.

Under these conditions, a reverberation unit will enable him to make really "live" recordings, surpassing in quality the recordings he can make without it.

SPECIFICATIONS

nput or Driver Impedance:
1500 ohms nom. at 1000 cps (Open Laminations)
.C. Resistance: 180 ohms
utput or Pickup Impedance:
2250 ohms nom. at 1000 cps (Closed Laminations)
.C. Resistance: 180 ohms
requency Response:
±3 db 200-4500 cps
ensitivity Test—
Input: Constant current 2.0 mA (19 mA max.)
Output: 2.7 mV r.m.s. (20 mV max.)
everberation Time:
2.0 seconds approx. at 300 cps
elay Time:
Long Spring .037 sec. nom.
Short Spring .029 sec. nom.
OTE: Delay time difference between long and short spring:—
No more than .0134 sec.
No less than .0026 sec.
ysical Dimensions:

Length	16¾in
Width	4⅜in
Height	1¼in
Weight	24 ozs.

A Review Of Sacred Records

FAITH OF OUR FATHERS, The Canterbury Choir, Conducted by Macklin Marrow; Organist, Ernest White. Mono, M-G-M 027559.

You'll look a long way for a better choral presentation than this one, of the great traditional hymns of the Christian Church.

With conventional organ accompaniment, the Canterbury Choir sings with a power and conviction that calls for no gimmicks or embellishments.

The hymns, "Faith Of Our Fathers," "Onward Christian Soldiers," "Lead Kindly Light," "Rock of Ages," "Abide With Me," "Nearer My God," "Holy, Holy, Holy," "Now The Day Is Over," "The Lord's Prayer," "Jerusalem, O Turn Thee," "God Is A Spirit," "O Lord Most Holy."

Technically the recording is above reproach, making it a disc which I can readily recommend, either for private listening or for use in church meetings.

★ ★ ★

BACK TO THE BIBLE BROADCAST, Volume 1, Presented by Dr Theodore Epp, Mono, R.C.A. L101108.

Since its initial broadcast in 1939, over a single station in Nebraska, the "Back To The Bible" broadcast has grown to

DO YOU LIVE IN A DIFFICULT TV RECEPTION AREA?

Then do as many others have already done and make use of our aerial amplifier, developed and manufactured by **FUBA**, W. Germany's largest manufacturer of aerial amplifiers and accessories. These amplifiers are made from precision high stability and quality components, and therefore perform at an extremely low noise level with a high output.

Available in 2 models: Masthead and distributing units.

Construction Details of Masthead Amplifier:
Cabinets constructed from special cast alloy to withstand weather and corrosion, completely waterproof and fitted with heat deflecting shield. Inlets for either 60-80 ohms, coax. cable or 300 ohm ribbon to order, 25V power supply which is supplied from primary power supply with tappings up to 32V to allow for loss in supply cable. Case will hold PS and two 2 valve ampls. Mast mounting from ½in-1½in.

Details of Distributing Units:
Pressed sheet metal cases (3 models) compl. with sockets, etc. to take various amplifying units and power supplies.
The amplifier units are built on a plug-in type chassis which have proved to be of great success in fast mounting or for quick service in case of breakdowns during operation.

Technical details:
Power supply 220-240 V AC. 3 models available for supplies of 18W, 25W or 50W. Dry rectifiers used.
Amplifier: cascode circuitry consisting of high quality components.
Frequencies: Depending on ampl., but available in all TV Bands single or broadband from 40 Mc-230 Mc input and output to order 60-80 ohms coaxial or 300 ribbon.
Gain: Depending on ampl.
In case of: 1 valve single Channel (frequency any Channel between 1-4), gain 23db, noise level 4db, output max. 1.4 V.
1 valve broadband, all Channels 1-4, gain 20 db, noise level 6db, max. output 0.7 V.
1 valve single Channel (any Frequency between 5-11) gain 21 db noise level 6 db, max. output 1.4 V.
1 valve broadband ampl. covering all Channels 5-11 gain 17db, noise level 7 db, max. output 0.7 V.
2 valve single Channel (any freq. betw. 1-4) gain 44 db noise level 4 db, max. output 0.7 V.
2 valve covering all Channels betw. 1-4, gain 34db, noise level 6db, max. output 0.7 V.
2 valve single Channel (any Channel between 5-11) gain 42 db, noise level 5 db, max. output 1.4 V.
2 valve broadband covering all Channels between 5-11, gain 30 db, noise level. 7db, max. output 0.7 V.

Valves used:
E88CC and E18OF, which are special developed, long life tubes with gold plated pins, guaranteed for 10,000 hours.

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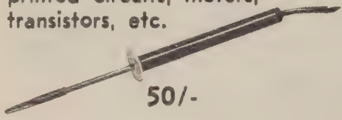

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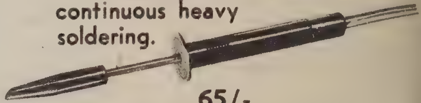

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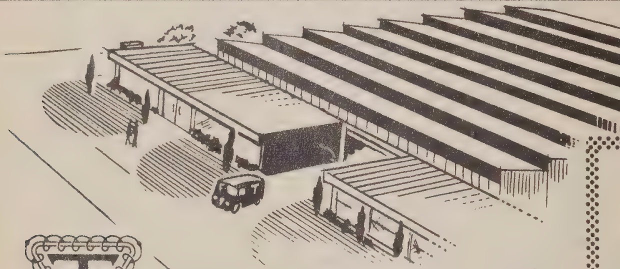

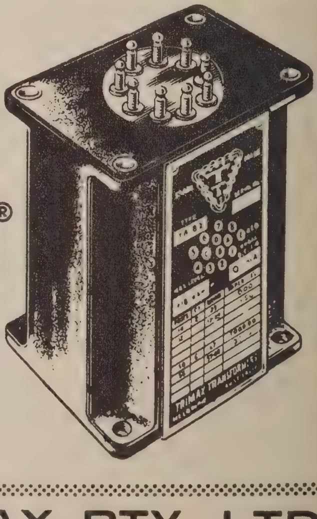

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Fifteen typical hymns are included on ıis disc, presented by the session's own ıale chorus, quartet and choir. Some re well known, others less so, but the iction in all cases is so good that the 'ords are easy to follow.

The general quality and balance of ıe disc is excellent, making it one which have no hesitation in recommending those with an interest along this line.

★ ★ ★

UST A CLOSER WALK WITH THEE, Patti Page With Choir, Arranged and Conducted by Malcolm Dodds. Mono, Mercury M.G. 20573.

This collection of spirituals is Patti age's first venture into the realm of re-gious music prompted, according to the acket notes, by her successful hymn-inging role in the film "Elmer Gantry."

Backed here by a sometimes incon-ruous forty-voice choir, she gives a sen-itive presentation of a dozen "standard" pirituals, ranging from the rollicking Great Gettin' Up Morning" to the earching "Were You There" and the ıeditative "Break Bread." You're pretty ertain to enjoy the disc if your tastes ın in this direction.

Technically, the quality is first rate.

★ ★ ★

LASSICAL MUSIC, Interpreted by Porter Heaps at the Pipe Organ. Mono. Summit WG-A-1122.

I include this disc among the "sacred ecords" because it contains excerpts of ıe type commonly used in churches as oluntaries.

Whether it will qualify as such, in the rict sense of the term, is another mat-er because, much of the time, Porter leaps uses organ voices, tremulant and echniques which belong more to the opular rather than the traditional organ eld. You'll either like or dislike the esult predominantly on this count.

The instrument, by the way, is the udio organ of radio station WGN, hicago.

Dynamic range, frequency response nd distortion level on the disc is about verage, but the background noise is oticeable enough to warrant a mention.

The contents: "Pilgrim's Song Of lope," "Andante Cantabile," "Symphony D Minor," "Air For G String," "Noc-urne In E Flat," "Nocturne" (Men-elsshon), "Nocturne" (Schumann), Told At Twilight," "An Album Leaf."

★ ★ ★

HE BELLS OF ST. PAUL'S CATHEDRAL, Melbourne. Change Ringing and Call Changes: Twelve Ringers. Directed by Mr G. W. Pipe. Mono. W. & G. WG-A-1039.

On the rather extensive cover notes, xplanation is given of what can be done ith different numbers of bells, including possible 479,001,600 changes when velve are used.

Even without going to such extremes, owever, the discipline and concentra-on needed from the ringers to produce e constantly changing yet systematic attern of sound, would be equalled only that necessary to analyse it on play-ack!

To most listeners this will simply be record of Cathedral Bells, sounding as ell-played bells aways sound. I nagine smaller churches will be able to use the disc—provided their amplifiers are equal to the not inconsiderable task of reproducing it.

The recording itself is quite good, though occasional street noises can be heard if you listen critically.

For those of whom the track titles mean anything, they are as follows: "Grandsire Caters" (10 bells), "Call Changes" (heavy 8), "Kent Treble Bob Minor" (middle 6), "Stedman Triples" (light 8), "Call Changes" (12 bells), "Stedman Doubles On The Pretty Six."

The Everest POP stereo sampler
the PRICELESS SOUND of EVEREST

THE PRICELESS SOUND OF EVEREST, The Everest Pop Stereo Sampler. Stereo, Everest, STELP 709.

Let there be no double talk about this latest "sampler" disc — it's tops in stereo sound, with superb definition, spread and dynamic range. There's a trace of background noise, to be sure, but it hardly counts.

On it you get tracks from "Gershwin in Brass," Gloria Lynne, Hank Williams, Dick Hyman's Zillion Strings, Gisele Mackenzie, Randy Van Horne, etc.—a total of a dozen well-chosen numbers.

Good "pop" entertainment and a natural for hi-fi enthusiasts who want to show off their gear.

IN VARIED MOOD

KISMET. Bobby Richards Orchestra. Conducted by Ken Alwyn. Produced by Cyril Ornadel. Stereo, World Light Record Club LM-7023.

Written by Robert Wright and George Forrest and based on themes of Alexander Borodin, Kismet is set amongst the palaces and mosques of old Baghdad. Because of its relatively short history—it was first performed in New York in December, 1953—it is probably less well known than many of the other musicals released to date by the Light Record Club.

Whether you want to make—or renew—acquaintance with this often boisterous musical, you need have no worry about the quality of the present disc. Voices and orchestra are reproduced with scarcely a whisper of distortion anywhere, though I must admit to a slight surface crackle here and there.

Kismet—meaning fate—is the story of a peddler's daughter and a prince, always good material for a musical, boisterous and often amusing. A brief outline is given on the jacket, but in more detail in the August issue of the Club's periodical "Showcase."

HITS OF THE THIRTIES. With Benny Lee, Jean Campbell, Lorie Mann, Ann Emery, The Linden Singers. Conducted by Ray Terry. Produced by Cyril Ornadel. Stereo, World Light Record Club. LM7024.

If your memories of popular music go back to the thirties, to the heyday of the talking film and sound broadcasting, you'll be a good prospect for this latest release of the World Light Record Club.

A few of the titles will indicate what I mean: "Broadway Melody," "Goody Goody," "The Music Goes Round," "Stormy Weather," "A Tisket A Tasket," "Thanks For The Memory" and "Sunny Side Up."

Quality-wise, the surface is near-perfect, the quality clean right through, but best balance will be obtained on wide-range gear with a spot of treble cut.

(Continued on Page 87)

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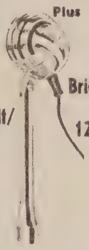

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- **Amplifier using six valves and rectifiers.**
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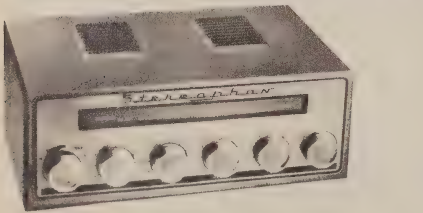

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mplete tuner and amplifier for stereo, comprising a compact Hi-Fi Stereogram in two units featuring a high gain
il wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls in one unit and
› Mullard 5-10 amplifiers with push-pull outputs and power supply on second chassis.

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ponse of amplifier 40 to 15,000 cycles.

THIS UNIT CAN NOW BE SUPPLIED WITH THE NEW ROLA 12 PX SPEAKERS

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ıe controls and two Mullard 3-3 amplifiers, power supply on separate chassis. Supplied with two Rola 8MX
:akers. Power output 4 watts per channel. Frequency response of amplifier 40 to 15,000 cycles.

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ble controls. Output 3 watts per channel. Supplied with two Rola 8MX speakers. Frequency response 50 to
.000 cycles.

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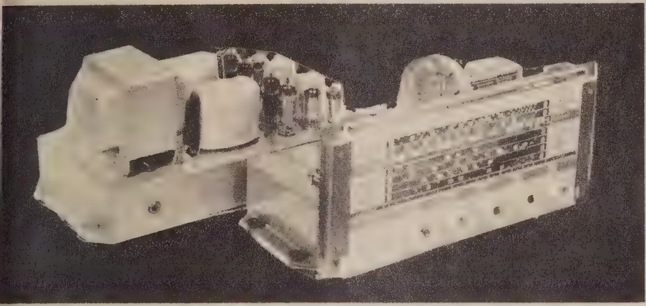

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nt interstate reception and a short-wave range of 12,000 miles. All
lves used are the new Mullard nine-pin Innoval series.

IEW:

ne control and audio stages incorporating the Mullard 5/10 amplifier
rcuit with separate bass and treble controls giving plus or minus
db boost or cut at 50 cycles L.F. and 10,000 H.F., combined with
sh-pull output with inverse feed-back gives you really high fidelity
production from your radio or favourite recordings.

IEW:

ual speaker combination using the new Jensen M.S.P. 12PR woofer
ith matched tweeter and cross-over network giving a frequency
sponse of 40 to 12,000 cycles. If required the Rola 12MX speakers can
supplied (with the 8 valve stereo chassis, two Rola 8MX speakers are
pplied). A.W.A. output transformers used on all units.

NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo F.M., or TV tuners and tape recorder.

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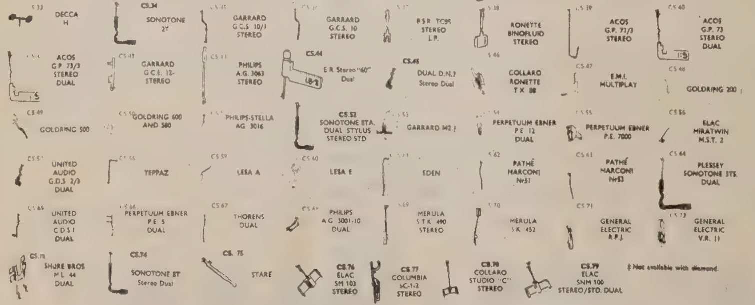

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IE SHEARING TOUCH, George Shearing with String Choir. Conducted by Billy May. Stereo, Capital ST1472.

Pleasant sound, easy on the ear, pretty ll sums up this latest George Shearing ic. It's the kind of sound that goes well th reading, eating or just plain relax-g.

The contents: "Autumn Nocturne," Nola," "Misty," "Canadian Sunset," utumn Leaves," "Like Young," "Sun-e Serenade," "Honeysuckle Rose," nowfall," "Tonight We Love," "Be-tched" and "One O'Clock Jump."

The quality generally is good though, a few spots, the piano transients will ek out pickups with limited compliance.

* * *

ISS SHOW BUSINESS. JUDY GARLAND. With Chorus and Orchestra Conducted by Jack Cathcart; Arrangements by Harold Mooney. Mono, World Light Record Club, LM7021.

No one, who saw the 16-year-old ris-g star in "The Wizard Of Oz," can il to have a tender spot for Judy Gar-nd. Nor, after the troubled years which llowed, can they begrudge her billing re as "Miss Show Business," the per-rmer with such outstanding ability on age to move an audience from laughter tears.

It's a very mature Judy, with a near-ntralto voice, who sings here a variety f medleys from her stage shows, Dixie umbers and the inevitable "Somewhere ver The Rainbow." Personally, I wish ie hadn't grown up but plenty of fans em to think otherwise.

Have no fears about the recording uality; a trifle bass-heavy but never-eless very good.

* * *

EA SHANTIES. The Male Chorus of the Robert Shaw Chorale. Conducted by Robert Shaw. Stereo, RCA SL16293.

If you had the idea that all sea shan-es were rollicking work songs, the obert Shaw Chorale will rapidly con-ince you otherwise. Contrasting with miliar shanties like "Blow The Man Down" and "Drunken Sailor" are ments like "John Stormalong," the omic "Drummer and The Cook," the ostalgic "Swansea Town," and so on, naking sixteen in all.

Needless to say, the Chorale sings em all with a good deal more finesse an I imagine the average crew would ave done and it's not surprising that ie atmosphere smacks more of the con-ert platform than the foredeck.

Quality-wise the disc is generally ex-ellent, except for a trace of rumble on ome tracks, that will only show up on laborate loudspeaker systems.

* * *

ONGS FROM SOUTH OF THE BORDER. John Gart at the Conn Electronic Organ. Stereo, London SAHA7554.

I thought, for a moment, that this was oing to be another one of those discs here the organ would only be heard hrough occasional breaks in the per-ussion.

Actually, howover, both are much bout level pegging, and followers of the opular organ will be able to evaluate oth the Conn organ and John Gart's vork at the console.

Both rate pretty well by theatre organ tandards, the Conn organ sounding at imes remarkably like a Wurlitzer pipe—irtually undistinguishable in fact.

The recording of organ and percussion is extremely good, marred only by a background of tape hiss.

* * *

PETE FOUNTAIN Presents JACK SPERLING And His FASCINATING RHYTHM. Drum Solos With Orchestra. Directed by Charles Bud Dant. Mono. Coral CL-30,072.

Jack Sperling is just about as busy as a featured drummer can be, as he whams and bashes his way through a dozen special arrangements, most of them acknowledged in one way or another to the big-name drummers of the big-name bands.

If you're a rhythm fan, you'll certainly find plenty to listen to on this disc. Similarly, if you like percussion and drums for the workout they give your speaker cones, you won't be disappointed either. It's good, clean sound, unmarred by record noise.

The titles wouldn't seem to matter much in this kind of presentation but they're listed on the cover along with their musical pedigree.

* * *

SONGS OF HANK WILLIAMS. Played by Billy Mure's Guitar and Orchestra. Stereo, SEL-930,034.

Around the campfire or in a small dance hall, this kind of sound might be a wow but, as an L.P. disc for the home, I doubt that it will interest any but a few teenagers.

Not that Billy Mure can't play the guitar, or there's anything specially wrong with the quality—it's just that the end result is so very routine.

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Though engineers should certainly find this disc very useful, it appears to be aimed, as much as anything, at the "enthusiast" market. Thus, instead of the relevant information being set out purely on the jacket, the nature and purpose of each track is included by way of narration.

The tracks include: Spot frequencies, each channel, 30cps to 15Kc; 1000cps zero level, each channel; 1000cps lateral cut; 1000cps vertical cut; percussive sound for acoustic balance of speakers; 150cps in-phase and out-of-phase signals; 3Kc flutter test; 400cps at 8db, 6db, 4db and 2db above normal recording level; two musical selections for final assessment.

My CRO showed that the spot frequencies to 15Kc could readily be played back as level signal voltages to the speaker, but the combination of the said speakers, room and particularly my aging ears would have led me to judge otherwise — unfortunately! Another track more likely to dismay than please is the one recorded at well above "zero" level but still not greater than the peaks reached by heavily recorded passages.

The musical selections at the end are brief but impressive, nevertheless, for their sheer weight and clarity.

A trace of background noise, plus a suggestion of "swing" on one or two tracks puts the disc out of the "perfect" class, but it provides interesting and useful test material, nevertheless.

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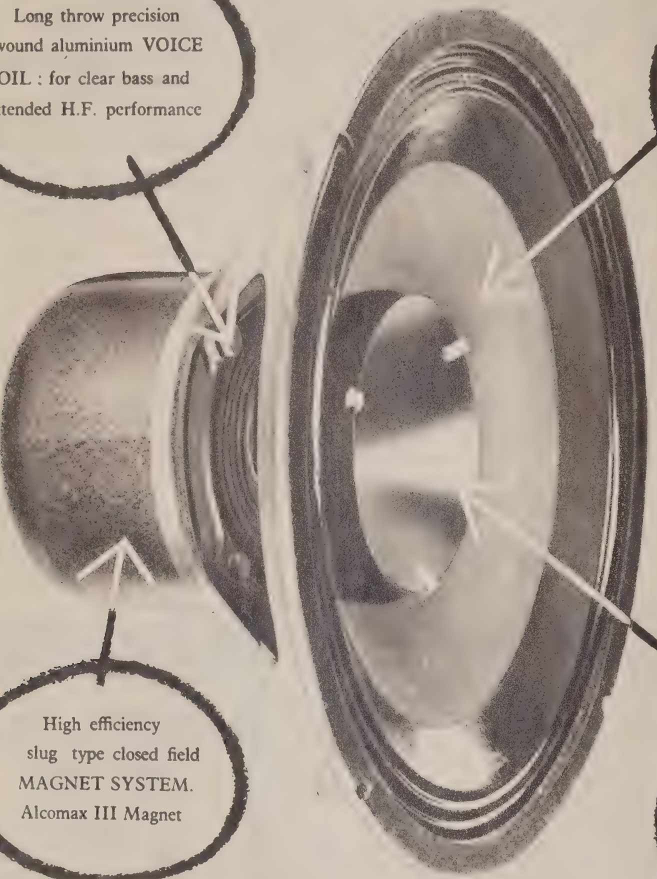

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IN REVIEW—By JULIAN RUSSELL

CHOPIN—"Rubenstein's Exquisite Art"

Chopin — Ballades (complete). Artur Rubinstein. RCA Mono L16285.

Chopin-players of outstanding merit are not rare nowadays, but Rubinstein gives me more pleasure most of the time than any of his rivals. And this is not to be explained glibly by the fact that he is of Polish birth.

Rubinstein, like Chopin himself, spent many years of his early manhood in France and thus added to his native feeling for the music an elegance that distinguishes the work of the best French musicians. And this added touch of gallantry in no way impairs the essential masculinity of his playing.

His structures are always strengthened by a beautifully articulated yet delicate skeleton on to which he adds beautiful curves of living flesh, warm, pulsating, and glowing with health.

Here is another example of Rubinstein's exquisite art, his touch, pearly yet responsive to the subtlest nuances, great reserves of power ready for use in the climaxes, rubatos which repay every loan from a previous bar to avoid impeding the rhythmic flow, and an overall aristocracy of expression that sets him, to my mind, above his fellows.

This set is, to me, the best available at present of the Ballade, and though it is possible it may be challenged by some competitor in the future, I cannot imagine it being excelled for a very long time to come.

* * *

Brahms — Symphony No. 4 in E Minor, Op. 98. Columbia Symphony Orchestra, conducted by Bruno Walter. Coronet Stereo KLCS2730.

Walter continues his remakes of the Brahms Symphonies with the Columbia Symphony Orchestra in this eminently pleasing account of the Fourth. His understanding of Brahms' music might best be described as wholly Viennese. He never forces the statements, but is content to let the music go along with the least possible intrusion of his own personality between it and his audience.

In an inevitable comparison with Klemperer's readings, Walter's have, most of the time, a lyrical placidity absent from the former. Thus his first movement lacks Klemperer's passionate drive, substituting instead a reflective quality which, on my set, called for a little more volume than usual to make its points.

But once this adjustment has been made, the music emerges in a richly varied glow which imparts an almost Verdian intensity to the melodic line. Moreover Walter's scrupulous attention to the balance of the inner voices thins out the texture of the scoring and avoids the lumpiness that might otherwise intrude.

The slow movement receives much the same treatment from the conductor and I suggest leaving the volume control at the same level as selected for the first. The scherzo receives as fine a performance as you'll find anywhere on disc, vigorous, fresh, and with a spring in its rhythms that imparts a youthful bounce to their often angular gait.

The Finale, however, I found disappointing. In this, the work does begin to lose a little of its stature. And just why Walter made so many changes of tempo is difficult to imagine. They finish by interfering with the beautiful logic of Brahms passacaglia and cut the movement up into episodes.

But on the whole it is still a fine Fourth, though you may prefer Klemperer's more assertive reading.

The sound is good, but if your equipment is more than usually sensitive you will need to cut down a trifle on the highs.

* * *

Mendelssohn—Mendelssohn in Scotland. Symphony No. 3, Op. 56. (Scotch); Fingal's Cave Overture, Op. 26. London Symphony Orchestra conducted by Peter Maag. Decca Mono LXT5601. Stereo SXL2246.

Some two years ago Peter Maag recorded an excellent disc of Mendelssohn's Incidental Music to A Midsummer Night's Dream that was outstanding in the grace and authority of its presentation of this hackneyed score. Even the old Wedding March sounded fresh enough to have been written yesterday.

He has repeated the same feat in the two works under notice here. The Symphony is treated as vitally as I've ever heard it. This is Mendelssohn without gentility emasculating the vigorous clarity of the outlines which always remain firmly etched on to their finely balanced backgrounds.

And the same might be said about the overture. Together with the Chicago Symphony Orchestra, the London Symphony is the most improved orchestra recording in recent years, and in these two pieces they are at the top of their form. The first-desk men are all first rate but seek no self-advertisement in primadonna presentation of their contributions.

The mono and stereo versions differ slightly. The treble is a little too prominent in the mono, while the bass grumbles a little—without the necessary adjustment—in the mono. But a few bars of either should enable you to set your controls to obtain fine sound from both versions.

* * *

Beethoven—String Quartet in E Minor, Op. 59, No. 2 (Second Rasoumovsky). Budapest String Quartet. Coronet Stereo KLCS2749.

This new recording is not to be confused with the set the Budapest made some five years ago. The performance is new and the playing vastly improved on the earlier issue.

The Budapest's co-ordination has always been admirable; here it is outstandingly unanimous. And though they must have played this quartet many hundreds of times, their presentation of it here is still deliciously spontaneous. Moreover, slight intonational lapses which marred the earlier performance have, except for one unstable spot on the viola in the slow movement, now been cleaned up.

On the debit side might be mentioned the unusually detached treatment of the "Boris Godounov" theme in the trio.

If asked to point out the "show" bits, I should choose the exquisite whispering in the Adagio — passages which can carry a message of great significance by just raising a pianissimo to a piano, and the beautiful resilience in the syncopation of the third movement.

The players' tone is rich and round, and the engineering faithful enough to place the quartet right in your room, an illusion that is helped by the immaculacy of the surface of my pressing.

* * *

Boulanger (Lili) — Psalm 130 (Du Fond de l'Abime); Psalm 24; Psalm 129; Vielle Priere Buddhique; Pie Jesu. Orchestra Lamoureux, with Soloists, Chorus and Organ, conducted by Igor Markevitch. Everest Mono EL-30,051.

Lili Boulanger died in 1918 at the age of 24, after a life in which she suffered much from ill-health. Yet she managed to find time to develop a style of her own and apply herself to composing works which, in the richness of their inspiration held a promise which, alas, was only to be partially fulfilled.

She was a sister of Nadia Boulanger, who, for a generation, was perhaps the most important teacher of "advanced" composition in Paris. And it is she who supervised this first recording ever to be made of her sister's compositions.

All the works are deeply devotional in character. The first, Du Fond de l'Abime, reminds me of Kodaly, without, however, my being able to match a single bar of the young French girl's to that of the Hungarian master. It is just the general richness of the scoring and the placing of the voices which recall the Psalmus Hungaricus.

There is more than a hint of Bloch from time to time in the 24th Psalm, with its scarlet brass glinting through Old Testament sombreness. And this, interrupted by splendidly joyous acclamations, provides excitement in every bar. There is nothing too difficult to enjoy at first hearing in this music. Despite rich modulations, the tonality always remains firmly fixed.

The broad contralto solo is beautifully shaped for the voice, and beautifully sung here in rich, steady tones which, I think, might be better described as mezzo-soprano.

The Vielle Priere Buddhique makes an extraordinary contrast. Here you find surprising gentleness and a true communication of the Buddhistic "will to Nothingess," to use Nietzsche's phrase. The tenor solo, which is delivered rather too throatily, is in a piquantly unrelated key.

A boy soprano is featured in the Pie Jesu, delivering a clean line of melody, purged of all but spiritual exaltation. And here, too, the solo is often in a key very remote from the accompaniment.

Fortunately, since the diction of choir and soloists is often very indistinct, a

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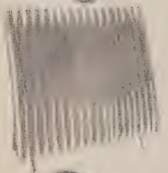

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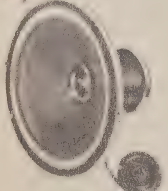

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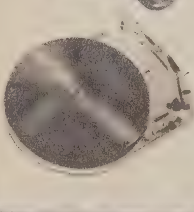

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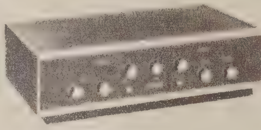

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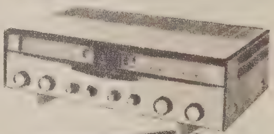

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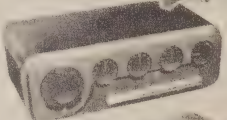

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text with an English translation accompanies the disc. Markevitch plays all the items with sympathetic understanding. The sound is a little thick in this mono version, but it may be thinned out in the stereo which is promised, although no date has yet been fixed for its appearance.

* * *

Beethoven—Symphony No. 5 in C Minor, Op. 67. Overture "King Stephen," Op. 117. Philharmonia Orchestra conducted by Otto Klemperer. Columbia Mono 330CX1721. Stereo SAX02373.

This is a heavily Germanic account of a work which responds ungratefully to such treatment—I was tempted to write ill-treatment. For Klemperer seems determined to use a beat of unvarying metronomic monotony which quite destroys the forward propulsion he usually manages to get into everything he plays.

Moreover, some of his tempos drag irritatingly enough to distract attention from the admirable playing of the Philharmonia. There are, of course, moments when the music catches fire and lifts the spirits temporarily. But they are too rare to be significant.

The sound is good, but not outstanding, and for some, the fill, King Steven Overture, because it is so seldom heard, might supply the deciding factor in favour of this disc.

* * *

Schubert—Moments Musicaux (Complete). Allegretto in C Minor; March in E Major. Claudio Arrau, piano Columbia Mono 33CX1709. Stereo SAX2363.

Many of these pieces have suffered from supplying material designed to display the improved technique of young students. In some instances their character has been changed to "simplify" their performance by inexperienced performers.

It is, therefore, a great pleasure to be able to listen to them "reconsidered" by one of the world's finest pianists. For Arrau virtually takes these modest pieces apart, discovers every nuance of mood, and reassembles them into an enchanting recital in which reflection is often substituted for off-hand digital skill.

Those used to hearing them the bad old way will be surprised by the refinements of Arrau's performance, and especially by the slow tempo he adopts in many of them. But he is persuasive enough to convince this listener that here is the way they should sound.

In only one, the Third, does Arrau make any radical alteration to what seems to be the accepted interpretation. His novel accentuation, which on close examination is formidably correct, will probably astonish many listeners. But the other pieces offer no such challenge to "orthodoxy" though every one is presented in Arrau's own inimitable manner.

He extends his reflective mood to the Allegretto in C Minor and seems to be having great fun with the little March, which slips from one key to another in a most beguiling way. The sound is first rate in both mono and stereo though I have still to be convinced that two-channel reproduction effects much change in the sound emerging from a solo instrument—except an organ.

Beethoven—Violin Concerto in D Major, Op. 61. Yehudi Menuhin and the Vienna Philharmonic Orchestra, conducted by Constantin Silvestri. HMV Mono OALP1799. Stereo OASD377.

It is not possible in the space available here to parse and analyse this performance side by side with its two closest rivals, played by Oistrakh and Stern respectively, and in doing so to establish detailed reasons for my preferring them to this eminently thoughtful reading.

But I must begin by emphasising that this was not recorded on one of Menuhin's "off days." There was a period some years ago when his playing was often unpredictable. Good and mediocre performances followed each other in a quite bewildering sequence. The most popular explanation dwelt on the difficulty Menuhin had experienced in changing from an intuitive stage as a prodigy to a more adult—and conscious—approach to the problems involved.

Menuhin has all his life been what some people might call a "deep" thinker—apart from some personal quirks such as Yoga, which he shares with others of a philosophical turn of mind. His period of adjustment was, therefore, more than usually protracted. But all that is past now and Menuhin has again established himself as a very great violinist indeed.

Why, then, my preference for either of the other two performances mentioned above? First, Menuhin's tone lacks the urgent sweetness of Oitrakh's, and his phrasing is just a trifle less assured than Stern's. But it is in comparing his treatment of the final Rondo that I choose one of the other two without hesitation.

Oistrakh and Stern bounce it along with exhilarating rhythmic resilience. Menuhin slows it up to a degree which makes it sound even a little glum, treatment which throws the whole work out of balance to this listener's ears.

There must, however, be many who share Menuhin's views on the Finale, and those who do will be happy to ignore the other trifling differences in tone and bowing. This is a matter in which your choice will be purely temperamental, and if you haven't already acquired either the Stern or the Oistrakh I suggest you listen to all three before deciding which to buy.

Silvestri's accompaniment is commendably modest when it should be, yet sufficiently forceful in the right spots. And the engineering is thoroughly efficient, though the stereo tends to separate the solo instrument ever so slightly too much from the orchestra.

* * *

Verdi — La Traviata. Complete Opera. Victoria de los Angeles; Carlo del Monte; Mario Sereni; Sergio Tedesco; Santa Chissari; Silvia Bertona. Orchestra and Chorus of the Rome Opera House, conducted by Tullio Serafin. HMV Stereo OASD 359/61.

I have little to add to my review of the mono version of this set, except to point out that the new two-channel version gives greater spread to the ensembles and opens up the texture of the climaxes effectively. However, the studio placing gives the impression that the engineers were satisfied to reproduce an operatic performance rather than one specially conceived, like Decca's "Tristan," for a stereo audience.

The performance as a whole remains

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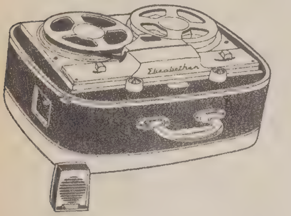

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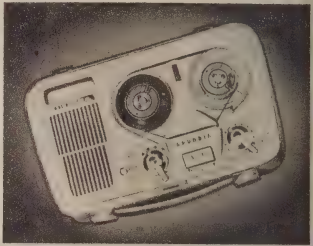

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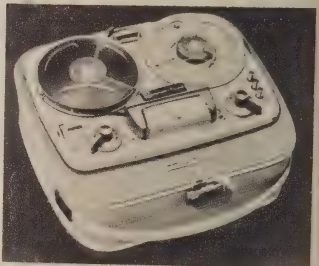

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eminently pleasing, though others will no doubt challenge it seriously in the near future.

* * *

Shostakovitch — Cello Concerto in E Flat. Mstislav Rostropovich and the Philadelphia Orchestra, conducted by Eugene Ormandy. Symphony No. 1 in F Major, Op. 10. Philadelphia Orchestra, conducted by Eugene Ormandy. Coronet Mono KLC2762.

This work, which Rostropovitch introduced to Australian audiences during his tour last year, has impressive symphonic stature. It gives us the leading Soviet composer at his very fine best, and can be placed without loss of status beside such works as the First and Fifth Symphonies, the Piano Quintet, and the Violin Concerto.

It was composed especially for Rostropovitch, and Shostakovitch himself went to America to superintend the recording. Not surprisingly in the circumstances, the performance is a definitive one. Rostropovitch's technique is unassailable, his range of expression as eloquent as it is wide, his understanding of the work complete.

In a work of such complexity, some occasional waywardness of intonation on an instrument which demands such wide stretches of the hand must be condoned. The compensations provided by the soloist are too richly generous for any but the most churlish of critics to quibble about such trivia.

The orchestra, too, gives a superb performance in complete sympathy with the soloist. The Philadelphia is a predominantly virtuoso organisation, but even among its outstanding first-desk soloists the horns call for special comment on their tone and agility. As to the concerto itself, this listener enjoyed every bar and repeated it several times during the first week it came into his possession, despite a pile of other discs clamouring for review.

And this is not the disc's only virtue, for in addition to the concerto, you will find as fine a performance of the First Symphony as ever I've heard. It leaves its two rivals, Ancerl's and Kurtz', far behind. It is beautifully rhythmic, brimfull of vitality, and recorded in sound of impressive richness. The stereo, of course, adds both width and depth to the mono, and, in the concerto, settles the question of balance between soloist and orchestra more satisfactorily than the mono.

* * *

Shakespeare — Excerpts from Plays and Poetry. Read by Sir John Gielgud. Coronet Mono KLC2743.

This is sub-titled "Part 2 of Shakespeare's Ages of Man" and is a companion disc to Gielgud's first recital of excerpts from the plays and sonnets. It contains two speeches from "A Midsummer Night's Dream," three from "Love's Labor Lost," one each from "The Taming of the Shrew," "Troilus and Cressida," "King Henry V," "King Richard II" and "Much Ado About Nothing," three from "Julius Caesar" and "Macbeth," the "Dirge" from "Cymbeline," four "Sonnets" and "The Passionate Pilgrim, No. 20."

It can be seen from this list that it includes many aspects of Shakespeare's genius and demands a wide variety of expression and technique. Gielgud's delivery is delightfully unmannered, and he has the fine Shakespearean actor's gift of conveying the meaning of archaisms with which the listener may not be familiar.

It should prove invaluable to schools, actors, both amateur and professional alike, and to all others who can find pleasure in hearing great poetry beautifully delivered.

RECOMMENDED

Falla — Nights in the Gardens of Spain. Gonsalo Soriano and the National Ochestra of Spain conducted by Ataulfo Argenta.

Rodrigo — Guitar Concerto. Narciso Iepes and the National Orchestra of Spain conducted by Ataulfo Argenta. Decca SXL2091 (Stereo). LXT5492 (Mono).

Lehar — Highlights from The Merry Widow and Land of Smiles. Schwartzkopf, Loose, Gedda, Kunz and the Philharmonia Orchestra and Chorus conducted by Otto Ackermann. Columbia Mono 330CX1712.

Rossini — Overtures to William Tell; Cinderella; Semiramide; The Thieving Magpie. Paris Conservatoire Orchestra conducted by Peter Maag. Decca Mono LXTA5556.

Schwartzkopf Sings Mozart: Arias from Figaro; Don Giovanni, Idomeneo; with the Philharmonia Orchestra conducted by John Pritchard. World Record TE249.

Strauss (Johann) — Graduation Ball. Weber — Spectre de la Rose. Willi Boskovsky and the Vienna Philharmonic Orchestra. Decca Mono LXTA5610. Stereo SXLA2250.

There's a strong chance that another reader has the very item you want for your experiments. The chances are he isn't using it! Why not advertise for it next month, on the blue page at the back of the book?

Vivaldi — Concerto in C Major for Diverse Instruments (with mandolines); Concerto in D Minor for Oboe, Strings and Cembalo; Concerto in C Minor for Flute, Strings and Cembalo; Concerto in C Major for Piccolo, Strings and Cembalo, Leonard Bernstein and the New York Philharmonic. Coronet Mono KLC2731. Stereo KLCS2731.

Schumann — Carnaval Meyerbeer — Les Patineurs. Royal Opera House Orchestra, Covent Garden, conducted by Hugo Rignold. RCA Mono L16277.

Prokofieff — Peter and the Wolf. Saint-Saens — Carnival of the Animals. London Symphony Orchestra conducted by Skitch Henderson with Julius Katchen and Gary Graffman (pianists) and Beatrice Lillie reading the lines. Decca Mono LXTA5577: Stereo SXLA2218.

Tchaikowsky — Capriccio Italien; Andante Cantabile: Glinka-Jota Aragonese: Rimsky-Korsakov — Tsar Saltan Suite. Paul Kletzki and the Philharmonia Orchestra. H.M.V. Stereo ASD343.

Schwartzkopf Portrays Romantic Heroines. Scenes from Tannhauser and Lohengrin (Wagner) and Der Freischutz (Weber) with Christa Ludwig (Mezzo-soprano) and the Philharmonia Orchestra conducted by Walter Susskind and Heinz Wallberg. Columbia Stero SAX2300.

Bach — Concerto in F Major (Italian); Partita No. 1 in B Flat; Partita No. 2 in C Minor. Glenn Gould (pianist). Coronet Mono KLC2733.

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AMATEUR BANDS WITH BILL MOORE

INTEREST IN NEW FIELDS

The interests of Radio Amateurs are by no means restricted to building equipment and conducting home and world-wide communication on the allotted wave bands. Their activity covers many wide fields and observations taken often assist other scientific bodies.

There are approximately 8500 amateurs in Britain, maintaining contact with a vastly greater number of amateurs overseas — an important contribution towards international goodwill and understanding. Pictured above is D. A. G. Edwards, of Birmingham, England, surrounded by a classic collection of QSL cards.

MOON Bounce projects are on the increase among radio amateurs. It is just over 12 months since the first amateur signals were bounced back from the moon. At present there are at least 30 interested groups in the U.S. alone, with some 12 of these actively engaged in construction of equipment for their moon-bounce endeavours. The original work was done on 1296 Mc/s but the new groups contemplate operation on other frequencies including 432, 220, 144 and 50 Mc/s.

Sam Harris, WIFZJ, QST, VHF Editor, provided in his section "World above 50 Mc/s" a review of the requirements for transmitting and receiving a moon-bounce signal in terms of dbs path loss for the various frequencies proposed. Loss at 1296 Mc/s was 271 db and at 144 Mc/s 252 db! The main problem on the lower frequencies is the physical size of antennas to produce adequate gain. A 150-foot diameter dish on 144 Mc/s gives approximately the same results as an 18-foot dish on 1296 Mc/s.

A recent visitor to the U.S. who inspected amateur moon bounce equipment was Dr Karl Lickfield, DL3FM. He is VHF Editor for the German National Amateur Society, the DARC. He has been granted a scholarship to produce a 1296 Mc/s moon-bounce installation in Germany. Much of his equipment is complete and experiments should commence by the end of the year.

The proposed amateur radio contribution to space communication project OSCAR according to reports is nearing fruition. The F.C.C. granted special authorisation for a test flight over San Francisco of a three-pound satellite packet containing a 100 milliwatt transmitter operating on 144 Mc/s. The OSCAR beacon transmitter's signals were received at good strength over a wide area and the transmitter and payload are ready for their ultimate trip into space.

The actual launching date at this stage is uncertain but it is hoped it will leave piggy-back with one of the planned U.S. satellite programs in the near future.

The project has created tremendous interest in amateur radio and other scientific circles in many countries. A large number of amateurs have volunteered their services to the project OSCAR Association and the scheme is fully supported by the ARRL. The project is a venture by the amateur for the amateur and will create valuable publicity.

It may be possible that little notice will be provided of the blast-off date of the 144 Mc/s Satellite and amateurs interested are requested to follow the ARRL's WIAW Bulletins or keep a watch for the news which will be spread around the world via the amateur DX frequencies.

An article in July QST covers project OSCAR measurements and tracking. All phases of such work are covered including the submission of reports, construction of a satellite track computer and Doppler shift measuring set-ups for the 145 Mc/s signal to be transmitted. To facilitate the submission of reports a standard form is being produced. A supply of these forms can be obtained from the Project Oscar Association at Box 183, Sunny Vale, California.

Amateurs often direct their activity along lines not closely allied to the service. A number of them have closely followed the orbits of the various satellites and the signals provided during these wanderings. As a result tapes are available covering transmissions which will be of great interest to many amateurs. Elmo Melton, W Zero AEQ, has produced one tape which covers recordings of more than 50 signals from over 25 earth satellites.

The first on the tape is from the first Sputnik launched on October 4, 1957, and continues with samples of signals from all satellites launched until the end of 1960. It covers some very interesting items including Pioneer V at one million miles in space, Russian Lunik just before it landed on the moon, President Eisenhower's Christmas Message from space, etc. Inquiries from interested amateurs should be directed to W Zero AEQ at 2901 East Meyer Blvd., Kansas City 32, Missouri, U.S.A.

The tape price is quoted at 5.95 dollars recorded on 1½ mil Tenzar or equivalent magnetic tape. Also available is a standard 45 R.P.M. vinylflex record containing 14 samples of transmissions received from most of the satellites launched between 1957 and late 1959. The sample recordings are authentic exactly as received by W Zero AEQ on his special receiving equipment.

An amateur you may have "met" over the air — Louis Varney, Chelmsford, Essex, England. For thirty years he has held the call-sign G5RV. (Pictures by courtesy of the U.K. Information Office).

Another field of activity for radio amateurs has been encouraged on Satellite Scatter Communications with the setting up of a special office by the Massachusetts Institute of Technology known as OSSC. It will co-ordinate research and other activity by amateurs working on such communications.

The director of the office is Ray, K2QBW, who with K3JTE made amateur radio history when they completed last year a contact believed to have taken place as a result of radio waves being scattered from an orbiting satellite. Frequencies of 20010, 28010 and 50010 are proposed for these experiments and the office will provide a means of co-ordinating results and the supply of bulletins covering operational data.

R.D. CONTEST

THE Wireless Institute of Australia Remembrance Day contest was as usual well supported with the 7 and 14 Mc/s bands carrying most of the activity. Conditions were quite fair with even 28 and 21 Mc bands holding up for reasonably long periods. Scores with a few over the 1000 mark will again be high especially when one station was around the 400 contact mark on the Sunday afternoon.

The opening speech by His Excellency the Governor of New South Wales, Lieutenant-General Sir Eric Woodward, K.C.M.G., C.B., C.B.E., D.S.O., K. St. J., reviewed the purpose of contest and the sincerity of the address impressed all listeners. His Excellency was introduced by the N.S.W. W.I.A. president, Bill Lewis, VK2YB.

The Governor paid tribute to the idea of an annual contest as a memorial to amateurs who fell in World War II. Such an event kept green the memory of the fallen while a stone or fixed memorial were often forgotten with the passage of time.

He spoke, too, of the work of the radio amateurs in emergency and their never-flagging watch on the air was responsible for the receipt of distress calls and the value of their inter-

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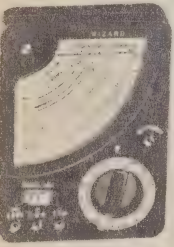

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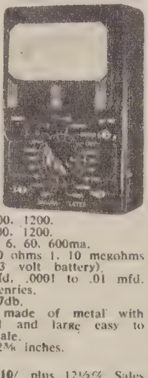

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32	35	13/4
33	36	13/5
36	40	19/7
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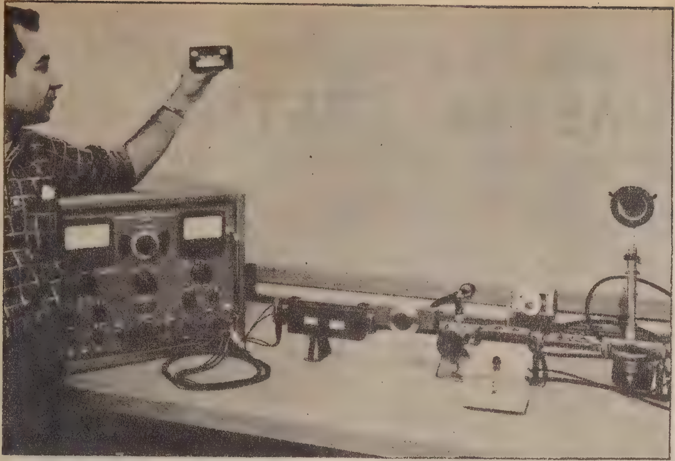

The apparatus set up on the table is a parametric amplifier, used for intercepting very weak signals, as from satellites, etc. By contrast, the technician is holding a tiny RF amplifier using two tunnel diodes, newly developed for this work by the Micro State Electronics Corp. of U.S.A. It is credited with a noise level of 2.5 decibels, the lowest figure yet achieved with tunnel diodes.

national working was providing a better understanding between peoples.

His Exellency also recalled his experiences with radio amateur operators during the disastrous 1955 floods in N.S.W. while he was General Officer Commanding Eastern Command. He said that amateurs were responsible to a large degree for communication with some 30 ducks operating in the flooded areas. He spoke, too, of the work of the Wireless Institute of Australia in fostering the work of the amateur radio service. After the address the N.S.W. president read the names on the Honour Roll and recited Bunyon's "Ode to the Fallen." The contest was then open and 7 Mc/s a mass of signals from all States. It is easily the best supported of all contests and a fitting tribute to those we remember. It is often the one occasion during the year when amateurs have an opportunity for a word with their ex-Service friends in other States.

SCOUT'S JAMBOREE

WORLD-wide support by national amateur societies and amateurs generally is being afforded the Scouts' Fourth Jamboree-on-the-Air. Many thousands of Boy Scouts in all parts of the world will be able to talk together on the various international and national contacts made. Australian amateurs will invite local Scout groups to their shacks over the weekend, October 21 and 22, the WIA is sponsoring the event in this country. Commencing at 0001 GMT on Saturday the jamboree will continue until 2359 GMT Sunday.

The Boy Scouts' International Bureau station will be as usual located in Ottawa, Canada. Using the call-sign VE3JAM it will be operated on 3750. 7210, 14195. 21195 and 28490 Kc/s during the jamboree period. A special QSL card for all contacts will be provided.

The Jamboree-on-the-Air provides the amateur service with an opportunity to assist a valuable youth movement. It can, too, give Scouts an insight into the mysteries of amateur radio, among them undoubtedly will be some future followers of the hobby.

LECTURES

LECTURERS for August at WIA, N.S.W., functions included a taped discourse on TVI presented at the mid-monthly meeting. Horry Oakes. VK2FA, provides the comment on the subject and covered its cause and cure. The keeping of friendships with neighbours becomes a little complicated in some fringe areas these days, hence the value of such a lecture. It is available with slides for club use from the N.S.W. division. The lecture was followed by a series of slides provided by Harold Burtoft, VK2AAH, covering Decca, a LF navigational aid used extensively in Europe.

Mr Harry Edwards, of the C.S.I.R.O., lectured at Science House in August to the N.S.W. general meeting. Despite the atrocious weather many members ventured out to hear an interesting discourse. The lecturer covered the normal types used by and known to amateurs and reviewed a number of special arrays such as the German Rhombic, etc., used overseas. A design for a Rhombic for TV reception was discussed and it will be described at a later date in "Amateur Radio." Perhaps it could solve some of the TVI fringe area problems.

It was an extremely valuable lecture on a field of general interest to all amateurs, whether they use the VHFs or HFs.

At the meeting Syd Molen, VK2SG, was presented with the Adams Cup, awarded annually to the N.S.W. amateur who provides the best technical article for "Amateur Radio" during the year. Syd received the award for his article on a 40-metre transistorised converter of matchbox proportions.

The August evening event of the N.S.W. VHF and TV section, a fox hunt, was won by Lance Phillips. VK2ZKP. Dave Andrews, VK2AWZ, was the fox and Lance found the spot in good time and gained maximum points, as he took the shortest route as well.

CONVENTIONS

WITH the arrival of spring most amateur bodies commence organising their conventions and field days. In N.S.W. the first two events on the program are the Hunter branch and south-west zones conventions. run over the Six-Hour weekend early in October. Scheduled for November are two field days—November 5 is the date for the Blue Mountains section's annual event, again to be conducted in the picturesque bush setting of the Lawson swimming pool. The day will include the usual field competitions, besides a few more special ones at the pool. There will be disposals, too. November is a good time of the year to make that Sunday trip to the mountains and a bush picnic. Registration will commence at 10 a.m.

Two weeks later, on November 19, the Gosford Radio Club, Central Coast section of the WIA, will conduct their well-known field day. They always attract large attendances from both Sydney and Newcastle. Gosford will be the venue and an extensive program has been

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Twenty popular designs are available, including combination Radio-TV-gram. All colours, first-class finish.

New models for stereo include built-in speaker enclosures and two and three unit sets. We will make your stereo furniture to order. Quotations given. TV cabinets can be supplied complete with brackets and straps for picture tube mounting.

ALL TYPES OF FOUR-SPEED AND STEREO RADIOGRAM UNITS

PICTURE TUBES NEW 23 in £25

TV ANTENNAS, 30 models, from £2
WRITE FOR CATALOGUE

H. B. RADIO PRODUCTS

103-105 Catherine Street,
Leichhardt, SYDNEY.
Telephone LM5580

TABLETOP TRANSMITTERS FOR THE RADIO AMATEUR

Our free catalogue describes our new high quality kits, complete units, and sheet-metal assemblies. Write or ring; we'll be happy to help you.

A. M. MONK & SON PTY. LTD.
13 Verity St., RICHMOND, VIC. Tel.: 42-5727.

CHANDLER'S for BASF MIRROR FINISH

Albert and Charlotte Streets, Brisbane

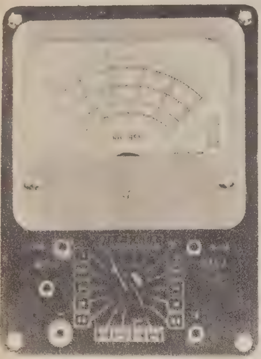
Magnetic Recording Tape

Beautifully Finished and Highly Sensitive

MULTIMETER TESTERS

EXCLUSIVE TO RADIO HOUSE PTY. LTD.

(Handy Size)



MODEL RH-955

MODEL RH-955

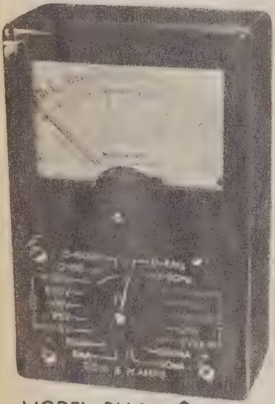
SPECIFICATIONS

* **Sensitivity:**
50,000 ohms per volt DC
5,000 ohms per volt AC
* **6 Ranges:**
DC voltage: 0-2.5-10-50-250-1000 volts.
AC voltage: 0-2.5-10-50-250-1000 volts.
DC current: 0-100uA, 0-10-100-500mA, 10 Amps. (all at 250mV)
Resistance:

Ranges	Centre scale
0-20,000 ohms	200 ohms
0-0.2 megs.	2,000 ohms
0-2 megs.	20,000 ohms
0-20 megs.	0.2 megs

Decibels: —20 + 46.
db 5 ranges (0 db 1mW into 600 ohms)
* **Dimensions:** 7in x 5¼in x 3in.
* **Net Weight:** 2½lb with Batteries.
* **Meter sensitivity:** 20uA

PRICE £23/16/-
Including Sales Tax.



MODEL RH-31

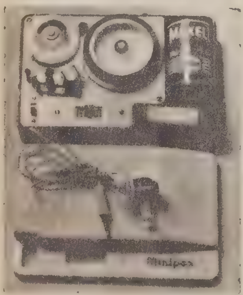
MODEL RH-31

* 20,000 Ohms per Volt on DC
* 10,000 Ohms per Volt on AC
* 3½" Meter
* 18 position selector

SPECIFICATIONS

DC Voltages: 0-5-25-100-500-1000-5000 (20,000 Ohms/V)
AC Voltages: 0-5-25-100-500-1000V (10,000 Ohms/Volt)
DC Current: 0-50 uA, 0-5-50-500mA
Resistance: 0-6K-600K, 0-6Meg-60Meg (30 Ohms, 3K, 30K, 440K at centre scale)
Capacitance: 100uuF--0.01uF, 0.002uF-0.3uF
Inductance: 20 H to 2000 H
Decibels: minus 20db to plus 30db in 2 ranges
Output Jack: for Audio measurements
Dimensions: (3⅜" x 5⅜" x 2 3-8")
Weight: (23oz approx.)
Complete with internal battery and testing leads with prods.

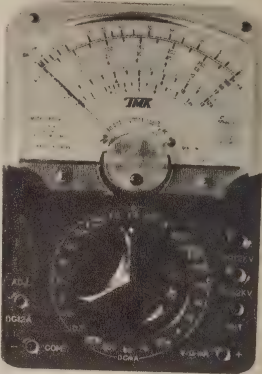
PRICE £12/5/-
Including Sales Tax.



TRANSISTOR TAPE RECORDER
Model 201 Minipex,
Dimensions: 5¾in x 3¾in x 1¾in. Fits into a pocket.
Priced £12/10/-.
Complete with earphone and mike combined.

SPECIFICATIONS

Fitted with batteries, Standard Torch Cell and 9 Volts Transistor Battery No. 216. Recording time 9 minutes. 60ft full Track Tape. Standard Recording Tape used 200ft for 9/6, enough to fill the supply reel 3 times. Variable Speed Control. Erases Automatically as it records. Freq. response 300cps to 4000cps. Weight approx. 1lb. Battery life 5 hours Standard Cell, 80 hours Type 950.



MODEL RH50

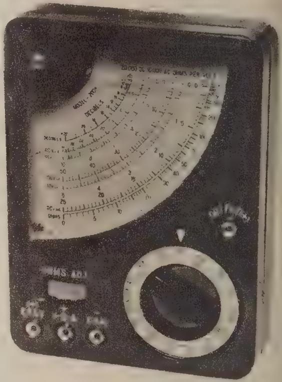
MODEL RH50

Modern Design. 33 Micro Amp Meter.
30.000 Ohms per Volt D.C.
13.000 Ohms per Volt A.C.
1 p.c. Multipliers and Shunts used.
Printed circuit.
Clear Scale, rugged moulded case.

SPECIFICATIONS

DC Voltages: 0-0.3-1.2-3-12-30-120-300-600-1,200 V at 30,000 ohms per volt.
AC Voltages: 0-3-12-30-120-300-600-1,200 V at 13,000 ohms per volt.
DC Currents: 0.06-6-60-600 mA, 0-12 A.
Resistance: 0-60K-6M-60M (350, 35K, 350K at mid-scale).
Decibels: —20 to + 57 db (0 db = 1 mW, 600 ohms).
Audio Out: Capacitor in series with AC volt ranges.
Short Test: Internal buzzer.
Accessory: 1 pair heavy test leads.
Batteries: 1 (1.5V), 1 (15V).
Size: 3 5-16in x 6 5-16in x 2¾in.
Weight: 1.4lb approx.

PRICE £15/10/-
Including Sales Tax.



MODEL RH-200

MODEL RH-200

20.000 Ohms per Volt DC
10.000 Ohms per Volt AC

SPECIFICATIONS

DC Volt: 0-5, 0-25, 0-50, 0-250, 0-500, 0-2,500
AC Volt: 0-10, 0-50, 0-100, 0-500, 0-1,000
DC Current: 0-50, Microamperes.
0-25, 0-250 Milliamperes
Resistance: 0-60K Ohms, 0-6Meg Ohms
Capacity: 0.01-0.3mfd (at AC 5 Volt)
0.0001-0.01mfd (at AC 250 Volt)
Decibel: minus 20db plus 22db
Output Range: 0-10, 0-50, 0-100, 0-500, 0-1,000
Battery used: UM-3-1.5V, 1 piece
Dimensions: 3¼" x 4¼" x 1 1-8"
Complete with internal battery, testing leads and prods.

PRICE £7/10/-
Including Sales Tax.

THE LATEST IN RADIOS

Imported Radio and Cigarette lighter combination. Size 3in x 1¾in x ½in. Beautiful plastic case holds both, 2 trans and diode radio and flip type lighter Earphone switches Radio on when plugged in. Complete with internal Mercury battery, felt pouch and presentation case. Cigarette lighter lifts out for filling. Spare batteries available. The ideal gift for smokers. **£7/9/6**

RADIO HOUSE PTY. LTD.

296 PITT STREET, SYDNEY.
Also at 760 George St., and 6 Royal Arcade.

aranged to cover both the OMs, their wives and families. More amateurs are making it a week-end jaunt, stopping at one of the many well-appointed motels at Gosford on the Saturday evening. Keep the weekend clear for the Gosford "do."

TVI PROBLEMS

Various divisions of the WIA have been considering aspects of TVI and the implications of operation in fringe areas. Perhaps some of these spots could be better described as beyond the fringe areas where optimistic viewers spasmodically see some sort of picture. Judging from some patterns seen recently 150 miles from Sydney, one would only have to walk past the receiver with a TX for the screen to blanket. Other matters include adverse publicity provided by one company who was prepared to blame one type of interference unconditionally on to the radio amateur, while it could be caused by any AM station. The Federal executive is collating the information provided with a view to further action should the need arise.

* * *

A scheme that places the rarer DX stations including DX-peditions in a particular section of the 14 Mc/s band has recently been supported overseas. The suggested segment is from 14100 to 14140 Kc/s. ZDIES, ZD3P, VP7BV and UG6KAA have operated between these frequencies with good effect. The transmitter that is being used in the rarer U.S.S.R. countries on DX-pedition basis will in future use crystal control on 14120 Kc/s. The suggestion originated in the RSGB's bulletin "Month on the Air" feature a year ago.

It was suggested as one way to assist the general stabilising on the band after the extension of the W Telephony allocation to the high end. With the falling off of conditions on 21 and 28 Mc/s an influx of additional stations to 14 Mc/s is anticipated.

The 15 Kc/s reservation between 14335 and 14350 Kc/s sponsored by the ARRL board of directors for DX SSB working is producing good results. On a gentlemen's agreement basis the allocation is approved by most DX operators. The U.S. amateurs have quite a frequency space problem on their hands with two-thirds of the world amateur population located in the U.S. alone and naturally there are a few individuals not enthusiastic about the scheme. With a span of 5,000 miles between the east coast of the U.S. and Hawaii the band is used extensively for domestic contacts as well as DX working, so the telephony allocation is full at all times. The ARRL urges all amateurs to observe the agreement and not to forget the gentle reminders to those locals who operate within the 15 Kc/s on the high end that the segment is set aside for overseas stations.

* * *

Most amateurs interested in winning operating awards these days are finding it difficult to obtain sufficient QSLs to submit with their claims. QSL exchanges are to a large degree out of fashion and the old habit of following every new contact with an exchange of cards as the final courtesy of a QSO forgotten. Not many years ago if an amateur contacted 100 different countries he could reasonably anticipate a return of more than 90 confirmations by normal QSL-ing via the bureau, no IRCs or begging letters required. The idea common today of returning a QSL when one is received is perhaps an easy way out of the responsibility of regular QSL-ing. The unfortunate part is that if everyone followed the scheme no cards would be exchanged. Many and varied are the approaches of individuals in their endeavours to build up their confirmed countries and area tallies, it is a pity that amateurs must resort to such activity.

W5RU has produced one of the most impressive methods seen to date. His pamphlet provides about the best expressed observations on QSL-ing printed and the sheet accompanies all cards sent out. It reads as follows:—"All through life we carefully preserve documents showing that in the year so and so we were born, or vaccinated, married, promoted, acclaimed, honoured and finally retired. These are valuable to all of us. The QSL that the ham finds in his mail box is his document of a worthwhile contact, tangible proof of his accomplishment. Without QSL cards there would be no DXCC, WAS. WAC, WAZ or other awards, the pride of achievement could not be realised. The ham works hard for his ticket, sets up his gear and makes worthwhile contacts. He looks forward to QSLs for confirmation. Not all hams are interested in QSLs but those of us who take the trouble to send QSLs of our own, accompanied by the necessary IRCs or stamps of the country worked deserve a little consideration. QSLs make me very happy. Won't you help by sending your card? Thanks, and may you be rewarded for your kindness and consideration." How could anyone refuse such a request?

* * *

Electronic keying has become increasingly popular in recent years and many and varied are the designs described to provide the dots and dashes. These devices are generally now called EL-BUGS. The original semi-automatic key was patented back in 1904. It was invented by H. G. Martin and marketed under the name of "Vibroplex." The trade mark was a small insect, hence the name bug. In the 1930s another type of automatic key was marketed providing both dots and dashes but it did not gain much popularity. Actually the first EL-BUG was described in QST in 1940 using a gas triode (thyratron) and WZILE was the designer. These electronic keying devices properly adjusted provide some beautiful Morse and seem to add an extra five words per minute to the usual copying speed.

ARTIFICIAL AERIALS

50 Watts RF 2-20 Mcs. Calibrated. Housed in Grey Crackle Metal Instrument Cabinet. Size 10in x 7½in x 9 1/4in.
With 190 uuf double spaced Variable Ceramic Condenser, Switches, Coils, etc. Weight with front cover, 14lb. Instruction book. Suit AT5 xmitter.

BRAND NEW 27/6 ea.

SCR522 TRANSCEIVERS
100-147 Mcs.
Complete with 18 valves.
Power supply (24v. DC).
Push button control box.
Circuit. **£8/17/6.**

6 VALVE ASDIC RECEIVER
(1) 5Z4. (1) 6V6. (1) 6K8. (3) 6K7. 240 supply. etc.
£4/15/-

AIRCRAFT LANDING LIGHTS
With High Grade Polished Reflector **9/6 ea.**

MICRO SWITCHES 3/- each

OAK SWITCHES
1 Pole 12 Position
2 Bank. **9/6 ea.**

JENSEN SPEAKERS 3½ inch with 6,000 Ohm Transf. **17/6.**

A.W.A. 2 Gang Condensers
Standard. 7/6 ea.
Miniature. 9/6 ea.

"S" METERS
ILLUMINATED 3MA. FSD
35/- ea.

FUSES
5 amp. and 500 mill. amp.
6d. ea.

Aluminium Carry Racks
with shock mounts. Ideal Mobile Rig 5¼in x 10¼.
New 12/6 each.

VCR97 Cathode Ray Tubes
6in Brand new in carton, as used in R. TV & H. circuits.
12/6 each or 2 for £1

13 Valves American Receiver. Type CG-46068 60-80 Mcs
£9/10/-

VALVES

6V6	12/6 ea.
6J6	9/6 ea.
2051 & 2050 Thyratron	9/6 ea.
VR105/30 & VR150	10/ ea.
6SN7 6SL7	10/ ea.
6J5	10/ ea.
6AC7	5/6 ea.
7C5 with Socket	5/6 ea.

Noise Limiter Kit
Navy Design 7, fit to almost any Receiver. Complete Kit of Parts and circuit with Instructions How to fit.
17/6 each

Fuse Holders (1 Hole Mounting)	2/6 ea.
Tag Strips, 1 Doz. Mixed From 4 Tag to 9 Tag,	7/6 doz.
TV IF Formers and Can with Slug	2/6 ea.
FORMERS ONLY	1/- Doz.
1mfd 600V Block Condensers	2/6 ea.
Phone Plugs	2/6 ea.
2 Phone Plugs with cords	4/6 ea.

Key Switches Asstd. Types	2/6 ea.
B/Cast Coils Aer. Osc. RF. Known make	5/ ea.
7-Pin Miniature Valve Straighteners	9/6 ea.
Relay Counters. 0-9999	7/6 ea.
Head Phones, low imp.	13/6 pr.
8mfd 440 volt A.C. oil filled	7/6 ea.
SCR 522 Control Boxes with 5 position Push Button Switches	12/6 ea.
70 Deg. Yokes New	30/- ea.
Carbon Mic Inserts	2/ ea.
Gramo Motors 240 Volt Suit Tape Recorders, etc.,	17/6 ea.
Bowden Cables. 6ft	5/ ea.

ALL ARTICLES PLUS FREIGHT

PARAGON RADIO
479 PARRAMATTA RD,. LEICHHARDT
LM9402 TOP TAVERNERS HILL

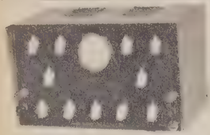
Amplification Communication Electronics

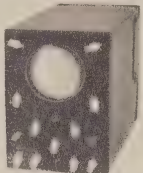
ACE RADIO

PHONE LA 3845

136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N-S-W

636 KING STREET NEWTOWN-LA7008





WIDE BAND OSCILLOSCOPE

5 Meg. Bandwidth. Push-pull vertical and horizontal Amplifiers. 8 position, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard-time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

3-inch £49/17/6 5-inch £55/15/-

VACUUM TUBE VOLTMETER

6 voltage ranges, 3, 10, 30, 100, 300, 1,000 volts AC and DC. 5 ohms, ranges 1 ohm to 1,000 megs. Contact. Potential compensated. Accuracy 1%. Provision for probe.

£29/15/0

DUO-PHONE 10 x 10 STEREO AMPLIFIER

10 watts per channel.
Valves 4.6BQ5. 2.7199. 4.EF86.
High Quality Transformers.
Input for Stereo. Gram. Mike. Tape.
Monaural. Radio.
3-Speaker Output.
Kit Set .. .. £49/10/-.
Wired and Tested £56/10/-.
Also with built-in DUAL WAVE TUNER. Including R.F. STAGE.

£66

NEW BATTERY CHARGERS

To charge 6V plus 12V plus trickle 2 to 12V.

3 AMP	5 15 0
4 AMP	6 15 0
6 AMP	10 15 0

Postage 7/6, 7/6, 12/6.

25 watt, 8 valve, P.A. 240 V.A.C. AMPLIFIER

Input for crystal mike, P.U. or radio with mixing facilities and tone control. High quality O.P. transformer for multi match O.P.

£23/17/6

Send for full details on Radiogram Chassis, TV and Amplifiers.

GUITAR AMPLIFIER

17 Watt 4 Input Channels. Bass and Treble Boost.
2 Twin Cone Hi-Fi Speakers.

£36/17/6

AUDIO OSCILLATOR

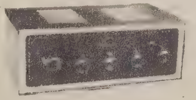
4 Band 20 Cycle to 200 K.C.
LINE AND SQUARE WAVE.
FULLY CALIBRATED.

£21/15/-

TV SWEEP GENERATOR

2 Band, on Fundamentals.
5 to 6 megs.
28 to 40 megs.
Sweep Bandwidth to 12 megs.
Tuner Frequencies on Harmonics.
Prodis Sweep Unit.

£37-10-0



Playmaster Stereo AMPLIFIER No. 2

7 watts per channel. Bass and treble boost. Dual push-pull. Hi-quality Ferguson or A& R O.P. transformers with ultra linear connections.

£42/0/0

(Post 15/.)

Also in Kitset form. £37/10/.

Also as above. 4 watts per channel. Same cabinet and control features. Ferguson output transformers. Frequency response. 30 to 20,000 cycles.

£26/17/6

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SPECIAL ACCESSORIES OFFER WHEN ORDERED WITH ABOVE UNITS.
2 8 W.R. SPEAKERS AND 4-SPEED STEREO PLAYER.

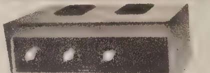
£14/10/0

(Post 15/.)

R. TV & H TV KITSET AS DESCRIBED IN THIS ISSUE

23in ----------	£99
21in ----------	£93

Wired and Tested. £12 extra.



MINIATURE P.A. AMPLIFIER. 15 WATTS OUTPUT.

Multimatch. Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing. P.P. EL.84 output. £17/15/.
As above, Mullard 5/10. Hi-Fi circuit. Bass and treble boost, etc. £21/15/.
Post: N.S.W., 10/: Interstate, 15/.

AMPLIFIERS

Public Address Range
240v-AC

6 Valve, 10 watt,	£14/17/6
6 Valve, 25 watt,	£25/17/6
7 Valve, 20 watt,	£22/17/6
100-watt	£63
40 watt	£35/15/0
50 watt	£39/15/0

Battery Operation

6 valve 6v, 10 w	£18/15/
7 valve, 12v, 12 watt,	£19/15/
7 valve, 12v, 25 watt,	£24/17/6

BATTERY-AC OPERATION

6 valve 6V plus 240V 10 watt,	£20/15/
7 valve 12V plus 240V 12 watt	£21/15/
7 valve 12V plus 240V 25 watt	£29/7/6

TRANSISTOR POWER SUPPLIES

12V DC input, output 150V, 200V, 300V, 400V at 150mA. 80% efficiency. For use with mobile equipment, transmitters, P.A., etc.
£18/10/. Post 7/6.

7 TRANSISTOR CAR RADIO

Amazing sensitivity. 2 microvolts. No noise. Brilliant tone. Using latest drift-type transistors. Complete with speaker, aerial, filter box, lead-in, etc. Fully tested and guaranteed.

£31/15/-

(Post 10/.)

State voltage, 6 or 12, earth polarity, speaker size and aerial required. Also available for special frequencies, Bushfire, Flying Doctor, small ships, Services, etc.

LEADER SIGNAL GENERATOR L.S.G. 10

240V A.C. Power.
6 Band. 1 p.c. Accuracy.
120 KC to 270 Megs.

£15/10/-

L.S.G. 11

As above. Range to 390 Meg.
Provision For Crystal.
An ideal TV Marker Generator.

£19/15/-

Post. N.S.W. 7/6: Interstate. 10/.

LEADER LSG.531

SWEEP & MARKER GENERATOR £72

Including Tax
240v. A.C. POWERED 2 to 270 Meg

K 20

K 20

MULTIMETER

20,000 O.P.V. sensitivity.
Ranges:
DC volts, 0, 10, 50, 250, 500, 1000.
AC volts, 0, 10, 50, 250, 500, 1000.
DC current 0.50uA, 0.25, 0.500mA.
Resistance, 0.50K, 0.05 meg, 0.5 meg.
D.B. minus 20 to plus 36.

£7/19/6

K50. 50,000 O.P.V.
Ideal TV Test Unit.
Current Range to 10 Amp.

£19/10/-

MODEL K.2

2000 O.P.V. Sensitivity:
Ranges as above except 50uA.

£5/12/6

Post, N.S.W., 3/6; Int., 5/6.

MODEL K.4

4000 O.P.V. Miniature.

£4/15/-

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LATEST 4-SPEED PLAYERS

240 A.C. Monaural	£7 5 0
240 A.C. Stereo	£9 5 0
Battery Monaural	£9 5 0
Battery Stereo	£11 10 0

Post. N.S.W. 7/6; Interstate, 12/6.

New Transporta 7

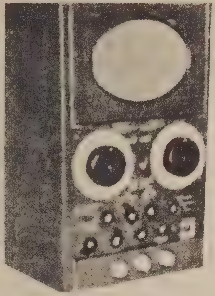
With R.F. Stage. 1 Watt Audio.
Using drift type transistors.
Improved range and performance.
KITSET £25/17/6
WIRED and TESTED, £28/7/6.

A Amplification **C** Communication **E** Electronics

★★★★★★★★★★★ RADIO

PHONE
LA 3845

136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N-S-W
AND 636 KING STREET, NEWTOWN — LA7008
EVENINGS and WEEKENDS: "KALUA," Hilma Street, Collaroy Plateau, XW5956
DULWICH HILL, UNDERCLIFFE, EARLWOOD BUS AT DOOR, STOP No. 42



AR8 Communications Receivers

12 valve. Converted to 240v A.C. Thoroughly Tested. Re-aligned. Latest Ovaltone Permag Speaker

£34/17/6

NEW VALVES

832A	19/6	VR75/30	15/
4D21	£4/17/6	RK48A	£3
12C8	12/6	954	7/6
VT501	12/6	VR105/30	15/
1C6	12/6	6AC7	5/
1J6	12/6	EL3NG	12/6
3B7	10/	2X2-879	5/
3D6	10/	6AJ5	9/6
304TH	£1/10/	VR150/30	15/
2050	£1	6AK5	17/6
6AM6	17/6	9006	5/
1K7	5/-	6AS7	12/6
1M5	5/	CK1013	15/
6J5	9/6	6SL7	15/
6J6	15/	EF39	12/6
6J7G	7/6	EK32	15/
6N7	10/	EBC33	12/6
KTW62/6U7	7/6	809	9/6
1D5	7/6	100TH	19/6
6F6	12/6	6AG5	9/6
EF37	12/6	7F7	12/6
5U4G	12/6	EL91	10/
12K8	12/6	EF73	10/
1T4	10/	EF72	10/
1P5	7/6	EC70	10/
6AG7	15/	2A3	10/
VT502	12/6	807	9/6
1L4	5/	2C26	7/6
6K6	7/6	RK34	7/6
AV11	3/9	1N5	7/6
6K7	5/	1C7	2/6
12SJ7	12/6	1Q5	5/
12SL7	12/6	1M5	5/
6SH7	7/6	7C5	12/6
47	12/6	7W7	7/6
843	£1/10/	12A6	5/-
1625	£1	6J8	17/6
5R4GY	£1/5/-	6C8	7/6
1629	10/	VR65	5/-
1619	£1	12AT7	10/-
RK75	10/	808	17/6
		12SK7	7/6

100 NEW ASSORTED RESISTORS

Mainly I.R.C. ½-1-2-5 watt. 40 wanted values, 15/. Post 2/6.

100 NEW ASSORTED CONDENSERS

Paper, mica, ceramic, electro. 25 values. 15/. Post 3/6.

NEW C.R.O. TUBES

3API-906	£1/7/6
5BPI	£1/17/6
CV112	10/
VCR138	17/6
VCR97	10/-
5FP7	17/6
CV322	7/6
VCR511B	£1/7/6

NEW POWER TRANSFORMERS

240v A.C. 50 cycle primaries. Standard 6.3 filaments.

300 x 300v 40mA	19/6
1960 5" CRO	£5/10/
1960 3" CRO	£3/15/
325 x 325v 150mA	£3/17/6
250 x 250v 180mA	£3/17/6
295 x 295 300mA TV	£6/15/
1200 x 1200v, 500mA	£10/10/
550 x 550 250mA	£3/15/
800v and 270v. 300 mA, ea.	£7/10/
10v 5 amp	£1/10/
240v-110v. 1.3 Kv. Auto	£10/10/
150 x 150V 30mA	£1 5 0
225 x 225V 40mA	£1 7 6
124V Doubler 300mA	£2 10 0
130V Doubler 400mA	£2 15 0

Vibrator Power Transformers

6V 300V 125mA	£3 17 6
12V 325V 125mA	£3 17 6

Inverter Transformers

6V 240V 40 Watt	£3 7 6
12V 240V 60 Watt	£3 7 6
32V 240V 60 Watt	£3 7 6
12V 240V 100 Watt	£4 5 0
32V 240V 100 Watt	£4 5 0

RELAYS

6V. 3-pole Miniature	15/
1700 SPDT	7/6
1300 SPDT	7/6
500 x 500 SPDT	7/6
12 volts DPDT, 5 amp	£1
12 volts DPDT	12/6
100pf TX var. condensers	10/
100 to 500pf 3000v. var.	10/
500 to 2500pf 750v. var.	10/
Hi-speed Polarised relay	£2/10/
400 ohm	12/6
6V Type 3000 DP, DT	7/6

Hi-lo Phono Transformers	4/6
Hi-voltage, Lead-thru Insulators each: 15/ doz.	1/6
Multi-strand 4-core Cable, yard	1/
60pf with Vernier	£1/1/
30 pf	10/
Throat mikes, new	3/6

OIL FILLED CONDENSERS

.5mfd 600V	3/6
2mfd 600V	6/6
1mfd 600V	6/6
4mfd 600V	6/6
4mfd 2.5K	£1/10/
1mfd. 3,000V.	17/6
.5mfd 5K .1 5K, .1 3K AC .25 4K .5 2½K	15/ ea.

VACUUM TUBE VOLTMETERS

5 ranges 1.5 to 150V. Good order.

£12/10/-

GENEMOTORS

Input	Output		
12v.	600v. 300mA	New	£5 10 0
24v.	250v. 100mA		£1 0 0
24v.	550v. 375mA		£2 0 0
24v.	250v. 60mA		£1 5 0
12v.	500v. 350mA		£8 10 0
12v.	1200v. 200mA		£6 10 0
24v.	250v. 100mA.	New	£2 0 0
12v.	235v. 50mA		£2 15 0
12v.	350v. 50mA		£2 15 0
24v.	540v. 200mA	New	£2 15 0
24v.	300v. 250mA	New	£2 15 0
12v.	275v. 110mA		£3 15 0
12v.	300v. 250mA	New	£2/15/

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Low Impedance.

American Lightweight	12/6
Australian DLR	12/6

USED

Tested DLR or CLR	9/6
Dynamic	17/6
Single. New Earpieces	2/

Post 2/6 Pair.

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Coils B/C, 455 KC	9/6
Coils S/W, 455 KC	9/6
Inters	11/6
Slug tuned H.F. coils to suit 44 meg.	4/6

WANTED

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ELECTRIC CLOCK MOVEMENTS

240v AC. Tested. Perfect order.

19/6

Post. 2/6.

GENEMOTOR SPECIAL

28 to 32v in. 300v, 250mA out. Operate TV from 32v.

Used £1/7/6,
New £2/15/-

NEW METERS

10mA centre zero, 3½in. scaled. 100-0-100mA. 300-0-300mA.

£1/10/-

10mA scaled 150-0-150V.

£1/10/-

1mA 4in square. Scaled volume units.

£1/17/6

5in lab. standard in cedar cases. 0 to 3 amp., 0-15 amp.

£3/15/-

0-10 amp, 0-500mA. 0-15 volt, 0-50 volt, 0-3,500 volt.

£3/-/-

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160 watt. 50 Cycle.
24v to 32v input.
Output can be supplied for 50-110 or 240v as required.
Suit radiograms, TV, tape recorders, fluorescent lights.

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American, National, H.R.O. Air Tested, Perfect Order. 6 Coil Boxes to 30 Megs. Crystal Gate, S. Meter, 2 R.F., 2 L.F. 240V AC.

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A.W.A. Version of Above Set. Similar Circuit and Facilities to 25 Megs.

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NEW MARCONI C100

6 Band 40 Kc to 30 megs. 10 valve, 2 RF 2.IF stage, 240 A.C. Fully Band spread. Air Tested.

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DR 106

PHILIPS TRANSMITTER. RECEIVERS.

50 to 80 megs. 240V. AC powered. 40 watts output. Excellent condition. less valves.

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Complete with Valves. Excellent Condition.

£8/17/6

522 Receivers. Complete with Valves	£5/17/6
522 Transmitters. Complete with Valves	£4/17/6

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New Dynaphon P.A. Units. Double ended with short reflex horns.

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American R.C.A. 20 Watt P.A. Speakers. Used. Tested. Perfect order.

£10/10/-

CARBON MICROPHONES

Respirator Type	2/6
Mark 3 Handmikes	5/6
Mark 7 Dynamic	12/6
Sound Powered	12/6

Post 2/6 Each.

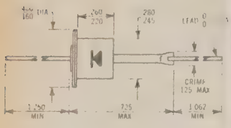
AIRCRAFT GENERATORS

28V. 100AMP. £12/17/6.
28V. 60AMP. £10/10/-.
12V 50 Amp £5-15-0

for Australia's widest range of ZENERS

MANUFACTURED BY WORLD FAMED INTERNATIONAL RECTIFIER CORP.

1 WATT RATED TYPES



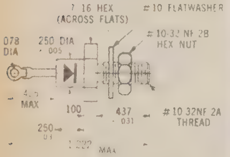
All dimensions in inches

Ratings and Characteristics at 25°C Ambient

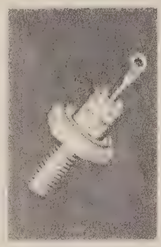
JETEC TYPE	INT'L TYPE	ZENER VOLTAGE RANGE VOLTS	TYPICAL DYNAMIC RESISTANCE @ Iz ma.	Zz (OHMS)	Iz MAX.	NOMINAL TEMP. COEFFICIENT %/°C
1N1518	1Z 3.9	3.6-4.3	50	9	250	.04
1N1519	1Z 4.7	4.3-5.1	40	8.5	200	0
1N1520	1Z 5.6	5.1-6.2	35	5.5	175	−.03
1N1521	1Z 6.8	6.2-7.5	30	1.6	150	+.05
1N1522	1Z 8.2	7.5-9.1	25	1.1	120	+.06
1N1523	1Z 10	9.1-11	20	1.5	100	+.07
1N1524	1Z 12	11-13	15	2.4	80	+.075
1N1525	1Z 15	13-16	13	5.4	65	+.08
1N1526	1Z 18	16-20	10	11	55	+.085
1N1527	1Z 22	20-24	9	18	45	+.09
1N1528	1Z 27	24-30	7	28	35	+.095

Over 1,584 hermetically sealed types in 5%, 10%, 20% and special voltage tolerance types. For basic Zener Diode application data, request Bulletin SR-250 containing standard Zener Diode circuits, detailed characteristics and selection data.

3.5 WATT RATED TYPES



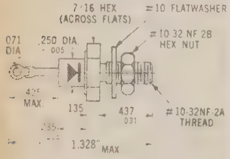
All dimensions in inches



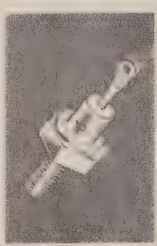
RATINGS AND TYPICAL CHARACTERISTICS

JETEC TYPE	INT'L TYPE	ZENER VOLTAGE RANGE VOLTS	TYPICAL DYNAMIC RESISTANCE @ Iz ma.	Zz (OHMS)	Iz MAX.	NOMINAL TEMP. COEFFICIENT %/°C
IN1588	3Z 3.9	3.6-4.3	150	2.6	850	−.04
IN1589	3Z 4.7	4.3-5.1	125	2.3	700	0
IN1590	3Z 5.6	5.1-6.2	110	1.4	625	+.03
IN1591	3Z 6.8	6.2-7.5	100	.58	525	+.05
IN1592	3Z 8.2	7.5-9.1	80	.5	425	+.06
IN1593	3Z 10	9.1-11	70	.7	350	+.07
IN1594	3Z 12	11-13	50	1.4	275	+.075
IN1595	3Z 15	13-16	40	3.4	225	+.08
IN1596	3Z 18	16-20	35	6	200	+.085
IN1597	3Z 22	20-24	30	9	160	+.09
IN1598	3Z 27	24-30	25	13	125	+.095

10 WATT RATED TYPES



All dimensions in inches



RATINGS AND TYPICAL CHARACTERISTICS

JETEC TYPE	INT'L TYPE	ZENER VOLTAGE RANGE VOLTS	TYPICAL DYNAMIC RESISTANCE @ Iz ma.	Zz (OHMS)	Iz MAX.	NOMINAL TEMP. COEFFICIENT %/°C
IN1599	10Z 3.9	3.6-4.3	500	.84	2500	.04
IN1600	10Z 4.7	4.3-5.1	400	.68	2000	0
IN1601	10Z 5.6	5.1-6.2	350	.3	1750	+.03
IN1602	10Z 6.8	6.2-7.5	300	.2	1500	+.05
IN1603	10Z 8.2	7.5-9.1	250	.25	1200	+.06
IN1604	10Z 10	9.1-11	200	.55	1000	+.07
IN1605	10Z 12	11-13	170	.95	850	+.075
IN1606	10Z 15	13-16	140	1.5	650	+.08
IN1607	10Z 18	16-20	110	2	550	+.085
IN1608	10Z 22	20-24	90	3	450	+.09
IN1609	10Z 27	24-30	70	4.5	350	+.095

ALL STANDARD TYPES LISTED AVAILABLE EX STOCK!

750 mW RATED TYPES ALSO AVAILABLE

Features:

- Extremely low dynamic resistance.
- Operating temp. to + 165°C (case).
- All welded hermetically-sealed construction.
- Low dynamic resistance at sharp Zener characteristics over the entire operating current range.

NEW! 250 mW and 400 mW

RATED TYPES in widest voltage range to date!

First to introduce the new International Rectifier subminiature range of glass 3.3—30 volt, 250 mW rated types, Warburton Franki is **first again** with a brand new line of glass 3.3—12 volt, 400 mW rated types. Both ranges are available in 5% and 10% tolerances and offer high stability and excellent voltage regulation over a wide temperature range (−55°c to + 150°C, 250 mW types, −65°C to + 130°C, 400 mW types). Extremely small size and glass-to-metal hermetic sealing assure a rugged unit capable of long-term reliability. Request Bulletins XSR-261 and 263.

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ADELAIDE:	**204 Flinders Street.,**	**W1711**
BRISBANE:	**233 Elizabeth St.,**	**31-2081**
MELBOURNE:	**359 Lonsdale St.,**	**67-8351**
PERTH:	**Tough Instrument Service Co., 993 Hay St.**	**BA7615**
SYDNEY:	**307 Kent St.,**	**29-1111**

ON SHORTWAVE — By ART CUSHEN

NEW HEBRIDES TESTING ON 3955Kc.

A new country to the shortwave bands, namely the New Hebrides, has been heard with test broadcasts from Vila in preparation for regular transmissions.

THE transmissions were first noted in early August, when the tests were carried out on 955Kc. from 0700 to 0900 GMT. The station ses both French and English identification and reuested reports to Radio Vila, Port Vila, New ebrides. The station also asked for comparisons f signal strength with those of Suva, Noumea nd Honeira. The program consisted of music f local origin and popular English tunes.

New Hebrides is a new country to shortwave isteners, though during the period of World Var II it was frequently heard on broadcast and, when the U.S. Armed Forces Radio was n operation from Esperto Santo.

The area is governed jointly by the United ingdom and France and this is the reason for he dual announcements. The station will service population of about 45,000 and the frequency hould provide us with fair reception in this area.

SEATO USING 6315Kc

A NEW voice on shortwave, that of the South-East Asia Treaty Organisation in Bangkok, hailand, has been heard with experimental broadasts to sign off at 1505 GMT on 6315Kc. The tation often has popular music to this hour nd classics are occasionally featured. At 1500, n announcement in Thai is made. This is ollowed by a march, which is faded for the ign-off announcements in Thai and English, hich, in turn, is followed by the Thai national nthem.

The English announcement is, "This is experiental station SEATO, on 1520 on your radio ial, and for shortwave listeners on 6315 kiloycles, 49 metre band. This concludes this transission. We will be back at the same time omorrow, so tune in again. Goodnight."

The signals in this area have proved to be etter on the broadcast band channel, which is ctually 1525Kc., but we should have improved ignals from SEATO Radio in the summer months t sign-off 1505 GMT on 6315Kc.

SINGAPORE FOURTH NETWORK

THE fourth network of Radio Singapore is on the air for cultural broadcasts and now operates on the schedule 1030 to 1530 GMT. The transmission is on 990Kc. medium wave and 4820Kc. and has news bulletins in English at 1130, 1330 and 1430 GMT. The station uses the frequencies which were formerly operated by the Chinese service from Singapore.

RADIO NACIONAL ECUADOR

THE reception of the test broadcasts of Radio Nacional de Ecuador in May has resulted in airmail verification from this new station. Radio Nacional broadcasts on 4940Kc. and uses 10Kw; the present schedule of the station is from 1130 to 0500 GMT. The station verification was in the form of a letter, pennant and program folder, which included photos of the transmitter and aerial systems. The station address is Radio Nacional del Ecuador, Apartado 1316, Quito. Writer of the verification letter is Gonvola Proano, Director of Programs of Radio Nacional de Ecuador.

VLF MELBOURNE

THE last of the projected 100Kw transmitters for Radio Australia in Melbourne was put into regular operation last month, when it commenced to carry transmissions to South-East Asia. The transmitter call is VLF9 on 9570Kc., carrying the transmission to South-East Asia from 0958 to 1730 GMT. The other service, on VLE15, using 15180Kc., has been extended, and this transmitter is now on the air from 0559 to 1300 GMT.

VOA EXPANSION

THE expansion of the Voice of America with further relay points in various parts of the world is announced by the United States Information Service, which operates the Voice of America. Subject to the necessary agreements being reached, new radio stations will be located in Sardinia and Turkey to service the Middle East area. Agreement has been reached to make the Courier a permanent fixture at Rhodes and extensions at the Salonika transmitting site are also being undertaken.

Another VOA station is to be built in Cyprus, while the Liberian station near Monrovia is due to commence operation next winter. In December, 1962, it is expected the VOA transmitters under construction in North Carolina, U.S.A., will be ready for service, with programs beamed to South America.

Plans for the extension of broadcasting in the Far East area have also been made by VOA, with initial tests in Australia, Christmas Island and the Philippines as possible areas for future transmissions to be broadcast in the Far East services. VOA at present operates stations in the Californian area, Hawaii, Okinawa, Philippines and Ceylon, which carry programs for listeners in the Asian area.

NOUMEA DROPS 6035Kc

THE frequency of 6035Kc. has been taken out of service by Radio Noumea, New Caledonia. The station, when opening at 0700 GMT, now only announces two frequencies, that of 1400 and 3355Kc. The frequency, in our summer months, at 0700 suffered some very severe interference from Monte Carlo, which uses the frequency of 6035Kc., as well as being a channel of Noumea.

BUENOS AIRES BROADCASTS

THE broadcasts from R.A.E. in Buenos Aires, which stands for Radio Argentina Exterior, are now carried on two frequencies. The service to Europe is transmitted on 11730Kc., 1900-2000 GMT in Spanish, 2000-2100 in German, 2100-2200 in Italian, 2200-2300 in French, 2300 to 2400 in English and 2400 to 0100 in Portuguese. The service to North America, East Coast, uses 9690Kc., 0200-0300 in Spanish, 0300-0400 English. To western United States and Pacific Coast, broadcasts are 0402-0502 in Spanish and 0502 to 0602 GMT in English.

HCOV5 ON 6100Kc

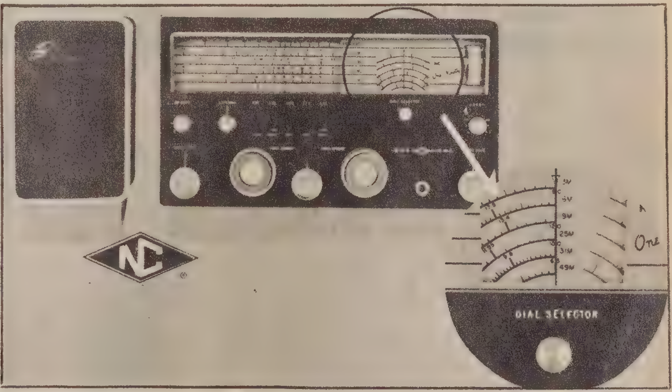
STRONG signals from HCOV5 in Ecuador have been heard on Sundays to 0700 GMT, when using 6100Kc., instead of the former 6140Kc. The increase in power to 15Kw. has also helped to give a strong signal in this area. The station has been noted with musical programs and, at times, up to two hours of such has been heard without any announcement, the only identification is given when the station leaves the air. The station uses the slogan "Ondas del Volante" and the address is Casilla 725, Azogues, Ecuador.

OAX6D USES 9350Kc

RECENTLY we reported the reception of the broadcasts of "Radio Continental" in Arequipa Peru on 9350Kc. to sign off at 0600GMT; verification from the station confirms the callsign as OAX6D. This 300 watt transmitter formerly used 3290Kc. but has been moved to this new frequency. The other shortwave transmitter OAX6E, was on 6330Kc. and has now been moved to 5930Kc. Both stations are on the air from 1100GMT to 0600GMT; verification is in the form of a postcard with a view of Arequipa taken from the hills behind the city.

ABADAN ON 1180Kc

SIGNALS from the Ivory Coast are reported by Dennis Parkes of Melbourne, where it is heard from 5030GMT. This new 100Kw. signal is good in Victoria from 0730 to 0800, but at 0800 has some interference from NHK in Tokio. The station has news in French at 0730, then a trumpet fanfare at 0745, program summary and then popular music until it is blotted out at 0755 by Tokio. On Sunday the session of popular music was replaced by "La Voix Esterance," a religious program. On the next frequency on Sundays ELWA Monrovia Liberia has been heard; this is on 1182Kc and not with English at 0730GMT.



Pictured above is the latest National Communications reciever, model NC-190, selling in the U.S. for 199.50 dollars. Covering from 540Kc to 30Mc. in 5 bands, it features double conversion and variable selectivity, using a ferrite filter system. The dial mechanism provides bandspread facilities, while a product detector allows full reception of SSB signals. Oscillators are voltage regulated. (Ad. Auriema Inc., 85 Broad Street, New York 4, N.Y.)

Enthusiasts in the U.S. who like to "roll their own" can purchase this new Knight-Kit R-55 Communications receiver. Coverage extends from 350Ks. to 36Mc. in four bands, with a fifth band covering from 47-54Mc. Two I.F. stages are used at 1650Kc.

ASSURED SUCCESS WITH R.C.S.

ALL TRANSISTOR CAR RADIO

PRINTED CIRCUIT ALL-TRANSISTOR CAR RADIO

Price for complete Car Radio Kit upon application

Car radio kit, Part No. 581, comprising 580 board, Aer., R.F., Osc. coils: 3 IF's, dial, cabinet, plugs and sockets, brackets and hardware.
£12/10/-, Sales tax iincluded.

CAR RADIO CABINET & DIAL KIT PART. 583. £5/18/9 tax incl.

TRANSPORTA 7

CAR IGNITION NOISE SUPPRESSOR

Part No. 28.
Consists of two RF and one laminated choke with a 1mf condenser, completely wired in a metal box. Connects in the active lead from the car to the Radio.

PART No. 28 .. .. £3/10/-
Sales tax included.

DIALS AND KNOBS

Part No.		
453	Dial and Knob 300 pf Gang	12/6
458	Dial and Knob 300 pf Gang	12/6

Sales tax included.

PRINTED CIRCUITS

Part No.		
558	Amplifier Audio Transporta 6 and 7	25/-
559	RF Section Transporta 6	75/-
562	RF Section Transporta 7	25/-
569	Audio and RF Section Transporta 4	25/-
568	TV Video Strip R. and H.	25/-
567	RF Stage 3 gang Transporta 7	25/-
580	Car Radio	37/6

Sales tax included.

COIL KITS

Part No.		
560	for Transporta 6	95/-
563	for Transporta 7	131/3
570	for Transporta 4	67/6
571	for TV Video Strip	75/-
575	for RF Transporta 7	128/2
581	for Car Radio coil and h'ware	£12/10/-
585	for Car Radio coils and choke	93/9

Sales tax included.

TRANSISTOR COILS AND IF's

Part No.		
248	Osc. Coil	12/6
249C	Aerial Coil with rod	£1
253	Car Aerial Coil	15/8
252	RF Coil	14/2
174	Single Tuned IF 455 Kc	14/2
175	Single Tuned IF 455 Kc	14/2
176	Double Tuned IF 455 Kc	14/2
177	Double Tuned IF 455 Kc	14/2
178	Double Tuned IF 455 Kc	14/2
179	Transporta 4 IF	15/10

Sales tax included

FILTERS

Part No.		
20	¾ amp Line Filter	35/3
26	¾ amp Line Filter	39/9
24	2 amp Line Filter	42/-
27	2 amp Line Filter	48/9
22	5 amp Line Filter	67/6

11 aer. filter kit, 116/8 (sales tax incl.).

R.C.S.

R.C.S. Radio Pty. Ltd., 651 Forest Rd., Bexley, N.S.W. LW3491-5385

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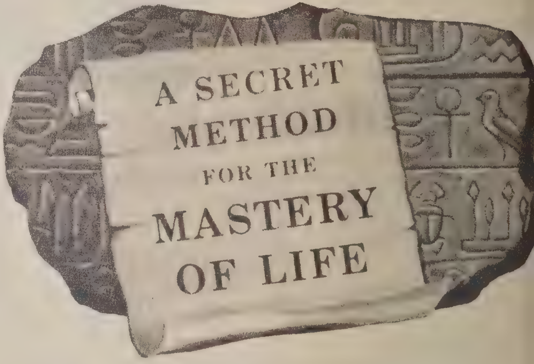
Today it is known that they discovered and learned to interpret certain *Secret Methods* for the development of their inner power of mind. They learned to command the inner forces within their own beings, and to master life. This secret art of living has been preserved and handed down throughout the ages. Today it is extended to those who dare to use its profound principles to meet and solve the problems of life in these complex times.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Please send free copy of Sealed Book, which I shall read as directed.

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FLASHES FROM EVERYWHERE

SPANISH GUINEA is being reported to sign ff at 2100GMT, when it uses 7850Kc., with oor signals. The station has popular Spanish usic, with announcements at frequent intervals Spanish.

LISBON in its service to West Africa, from 815-1930 has returned to 15290Kc. in chain ith 17895Kc. The session in English also carries e announcement that experimental transmissions re also being made on 6025Kc.

BELGRADE with its broadcasts over Radio ugoslavia is using the following schedule for s English transmissions: 1530-1600 on 9605. 1735, 15240Kc.; 1830-1900 on 6100 and 7200Kc.; 200-2215 on 6100, 7200 and 9505Kc.

SOUTH AFRICA, mentioned in this page last onth has made a recent frequency alteration nd replaced the 15300Kc. channel with the new ne of 15080Kc. This transmitter is on the air om 1700 to 2000GMT. English programs are n Tuesday, Thursday and Saturday, while another frequency used, 25800Kc., is now reported be inactive.

ELIZABETHVILLE in Katanga has been noted n 3955Kc. It uses 20Kw. on this channel and ives good signals in Europe. The program is at of the Home Service of Radio Katanga and he best reception has been from 1800 to 900GMT, with sign-off at 2100GMT.

AMMAN in Jordan with the Hashemite Broadasting Service programs has also made frequency hanges; its programs in Arabic are on the air 530 and 11810Kc., from 0615 to 1300GMT; lso on 7155Kc. and 11810Kc., 0330 to 0600 and 400 to 2200GMT.

FREETOWN in Sierra Leone, has been noted n 3305Kc. from sign on at 0600GMT. The ation has a session of local news at 0655 and, 0700, takes a relay from the B.B.C., London, f its regular news bulletin broadcast in the eneral Overseas Service.

MARTINIQUE is reported from North America being heard from 0100 to 0207GMT on 3315 nd 4895Kc. The latter is a new frequency and has some interference from a Brazilian station North America.

CARACAS station Radio Rumbos, which has een using 11870Kc. has been now heard on 1725Kc. and noted at 0300GMT.

AFRICAN STATIONS have been reported on ew channels. Southern Rhodesia, Gweloe has een noted at 0400GMT on 3306Kc. Lusaka ses 3975Kc. and Nairobi on 4850 Kc. at 300GMT.

HAVANA station COCW, which operates on 435Kc. is being received in Europe to sign off 0500GMT. This station has time announceents each minute and the program consists a continuous news session in Spanish.

NOTES from readers should be sent to Arthur Cushen, 212 Earn St., Invercargill, N.Z. All times are GMT, 8 hours behind Western Australian time, 10 hours behind Eastern Australian and 12 hours behind New Zealand time.

GABON has been reported with increased gnals in some areas of the world and the test schedule indicates the use of a 25Kw. ansmitter. Radio Gabon is scheduled to opere on Monday to Friday 0530-0630, 1100-1300, 700-2100GMT. On Saturday and Sunday the ansmission includes 0700-1300 and 1700-2100. he frequency of 4785Kc. is used for the first d last transmission and the afternoon service on 7220Kc.

RANGOON in Burma has moved its frequency the 49M. band and has been heard on 6090Kc. he transmission is that of the English broadcast d is heard with news at 1500 and sign off 1515GMT. The station gives a program mmary for the broadcasts for the next day efore it leaves the air, and uses only the nouncement, "This is B.B.S., The Burma Broadsting Service."

HONDURAS provides fair signal on Sundays ver HRLP "Radio America," which uses 050Kc. The station closes soon after 0600GMT d at this time suffers some interference from e B.B.C., London, which has a news bulletin English for European listeners on the frequency. Radio America" uses only 500 watts and is cated in the capital of Honduras Teguicigalpa.

AFGHANISTAN is reported to have reverted its English broadcasts to Europe and a Swedh report gives the frequency for the service 17830Kc. The English session is at the same me as previously, 1900 to 1930GMT.

BUDAPEST in Hungary has English broadcasts follows: For Europe, 2000-2030, 11910 and 33Kc.; 2200-2230, 11910, 9833 and 7220Kc. German, for Austria, from 1800 to 1830GMT. sing 7200Kc. To North America in English, om 0000-0030 on 15415, 11910, and 9833Kc.; so 0330-0430 on 11910, 9833 and 7220Kc.

VENELUELAN station YVKP "Radio Tropil" in Caracas, as well as being heard at 030GMT, has also been heard with programs after 0600GMT. The station uses 4860Kc. and s been heard with Latin American dance music d with station slogans given after each numer. This signal together with "Radio Santa Fe," Bogota, Colombia, are now the only two sigals noted on this band to after 0600. The olombian station uses 4965Kc. and appears at mes to broadcast throughout the night.

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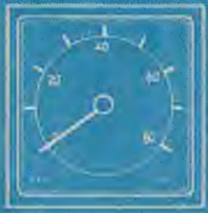

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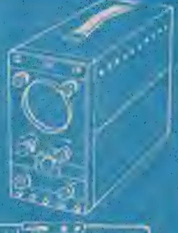

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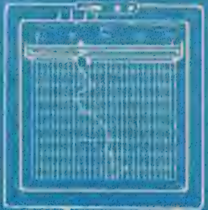

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UG/F.P.54

ANSWERS TO CORRESPONDENTS

J.K. (Balwyn, Vic.) says that he is very interested in electronic music but can find very little of it on records. He wants to know the names and/or numbers of records available and titles of books on the subject.

A.: We have seen a fair number of magazine articles on the subject through the years but have kept no list of references which we can quote. As for titles of books, we imagine that the best place to try would be technical libraries in Melbourne. The only record currently in our possession is one from R.C.A. on "The Synthesis Of Music," being a discussion of sounds put together on the R.C.A. Sound Synthesiser. This contains several short musical excerpts. We take it that this is the kind of thing you have in mind, as distinct from electronic organs, etc. (In case other readers may be able to help, the address is J. Kruithof, 321 Whitehorse Road, Balwyn, Vic.)

* * *

R.J.G. (Auckland, N.Z.) encloses newspaper clippings regarding methods of silencing television receivers during advertisements.

A.: Thanks for your letter and for the enclosed clippings. Though addressed to the serviceman, you will note that by now the matter has been discussed in the "Let's Buy An Argument" columns.

* * *

G.R.P. (Auckland, N.Z.) writes to tell us about an argument in the city regarding how best to silence temporarily the loudspeaker in a television receiver.

A.: Yours is one of several letters on the subject but we nevertheless were interested in what you personally had to say. The points which you raise have all been covered in "Let's Buy An Argument" for August.

* * *

T.S.C. (Singapore) asks us if we can supply any information on "low voltage alternator sets used by automobiles" and utilising a diode rectifier system.

A.: We regret that we cannot offer much in the way of assistance in this regard, T.S.C., apart from mentioning the general principles involved. As you are no doubt aware, modern cars have a considerable number of electrically operated functions, each of which places some drain on the battery. The car's generating system has to be able to supply sufficient charge to keep the battery voltage up to the required level.

The heavier the drain on the battery the higher the charging current has to be, and consequently the generator must increase in size proportionally.

A practical limit is currently being reached, however, and the present trend is to use an alternator with its much higher efficiency rather than a generator and to rectify the AC voltage by means of a suitable diode. Indeed, some systems have incorporated transistors into the circuitry so that they provide electronic voltage regulation at the same time. We have no detailed information on commercial units at the present time, nor are we in a position to suggest the "do-it-yourself" approach.

* * *

D.J.S., Epping, N.S.W. asks concerning drift in the horizontal oscillator of his 1959 TV receiver, necessitating frequent hold correction during warm-up. He also asks if broken vertical lines in certain program material is due to a receiver fault or originates at the transmitter. In addition he would like to know if a push-pull output transformer designed for a 5000 to 8-ohm match could be used for a 10,000 to 15-ohm match.

A.: Drift in the horizontal oscillator circuit should not be so serious as to require correction during warm-up, D.J.S. If it appears that the drift is excessive, we suggest you carefully check the components in the synchroguide circuit. In a couple of cases we have come across, instability has been due to the use of high-K capacitors, which are temperature sensitive.

The broken vertical lines are most likely due to faulty video tape.

The transformer could probably be used with the alternative impedances mentioned, as the turns ratio is almost the same. It should be borne in mind however, that there may not be sufficient inductance present at the new impedance and consequently the bass response could suffer accordingly. An index for volume 16 is in course of preparation and will be published when space is available, for the sake of those who have specially requested it.

* * *

K.J. (West Perth, W.A.) sends us a long list of questions covering a very wide variety of subjects, from direct coupled amplifiers to the behaviour of locomotives under load.

A.: Unfortunately, K.J., a great many of your questions are quite outside the scope of our query service which, in the main, is intended to assist readers who have particular problems with any of our projects. Most of the "popular science" type of questions you have submitted could be answered by any good text book or encyclopedia at your nearest public library. Some of the remaining questions may be of general interest to other readers and we will endeavour to answer them on this page or in the "Answer Tom" section when space permits. Finally, on the subject of amplifiers, we feel that various suggested designs and ideas are not very practical. It would seem to be much more satisfactory to follow a well proven design, such as one of the many described in the magazine over the past few years. The best of these are capable of a very high order of performance which would be difficult to better, or even match, with the designs you suggest.

* * *

C. M. B. (Kelvin Grove, Brisbane) compliments the magazine on behalf of the Northern Command Signals Amateur Radio Club, of which he is secretary. He adds that the club would like to see more articles on VHF and UHF equipment, but not at the expense of the many and varied articles published now.

A.: Thanks for the kind words, C. M. B. and we'll try to keep up to our past standard. Unfortunately, with the size of the journal governed by economic considerations, it is not possible to increase the space devoted to one subject, except at the expense of another.

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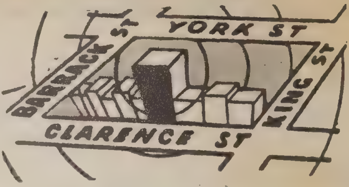

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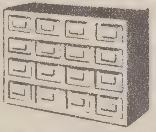

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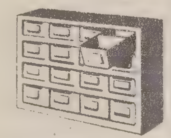

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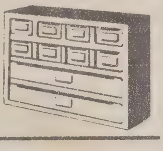

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Battery used: UM-3-1.5V, 1 piece.
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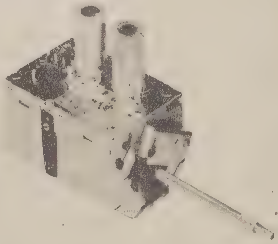

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LET'S BUY AN ARGUMENT

(Continued from Page 75)

and forth across the desired station, adjusting first one trimmer then the other until the signals sound the loudest.

Adjusting the trimmers in this way at the high frequency end of the band substantially balances up the differences in circuit capacitance, which often represent a major source of discrepancy.

If the gang sections are closely matched, as they should be, and the coils have the same inductance, the circuits will remain in step over the whole band.

EARLY PRACTICE

This much represented the accepted technique for many years and "old hands" in the radio trade will remember the coil testing set-ups in factories used to adjust accurately the inductance of solenoid wound coils. More recently, with the introduction of ferrite cores, it has become possible to vary the inductance of individual coils over quite a wide range by varying the position of the core in the coil.

It has thus become possible to obtain quite accurate tracking by using trimmers to balance stray capacitance at the HIGH frequency end of the tuning range and cores to balance inductance at the LOW frequency end.

Getting back to the crystal set in question, no ferrite cores are available to adjust the inductance of the large solenoid windings which were specified, so that tracking relied almost completely on the instruction to make coils absolutely indentical. By adjusting the trimmers at the HIGH frequency end, it was envisaged that results would be acceptable over the whole band.

In fact, this was the way it worked out in the original receiver and, presumably, in most other copies of it which were made. Leastwise, we have had no other complaints which would suggest that it didn't.

The most obvious assumption is that this particular correspondent may have miscounted the turns on one coil, or used a slightly different gauge of wire, or a different former diameter or mounted the coils in such a way that the inductances became unbalanced. Adjusting the trimmers at either end would thus peak the signals in that region but, elsewhere, the two circuits would be tuning to quite different frequencies.

If there are obvious differences between the two coils in question, then the cure will be equally obvious: Make them the same!

If they look the same but act differently, then different measures are called for, aimed at balancing the two inductances, despite appearances. Here is how to go about it:

Keep the aerial and crystal tappings as close to the earthy end of the coils as possible, consistent with a workable signal level. If it can be managed to keep them both at equivalent tapping points, so much the better.

Tune to a station near the HIGH frequency end of the band and, rocking the dial to and fro across it, adjust the trimmers for maximum signal strength. If the trimmers can be manipulated so that they are both within their workable range — not hard in or hard out — so much the better, once again.

Now tune to a station near the low frequency end of the band. Select either one of the trimmers, note its position carefully, and try screwing it in by a turn or so, rocking the dial at the same time to see whether the signal is thereby made louder.

If not, return it to its original position, then unscrew it by a turn or so and again note the effect on signal strength.

MODIFYING THE COIL

If screwing the trimmer in improves matters at the low frequency end, then the associated coil has less inductance than its opposite number. Either turns will have to be added to the one or removed from the other.

Do this a turn at a time, and repeat the whole procedure until trimmer settings determined at the high frequency end of the band, where they are most critical, hold good for the low frequency end as well. When you've achieved that A.D., your problems will largely have disappeared.

The final step would be to experiment with the tapping positions for aerial and detector, using the actual aerial and the phones with which the set is ultimately to be used. Strike the best compromise between selectivity and signal strength, re-checking the trimmers while so doing, then checking the inductance for good measure.

That done, the set should perform as well as a crystal set can under the particular conditions.

And one final thing: You don't have to carry a screwdriver while listening!

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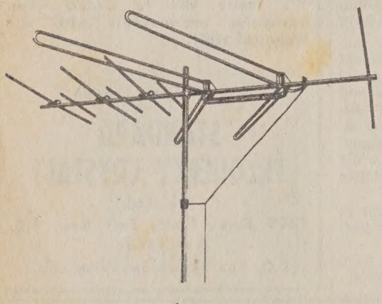

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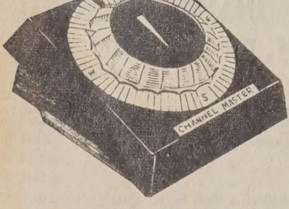

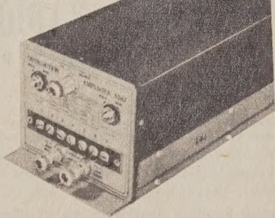

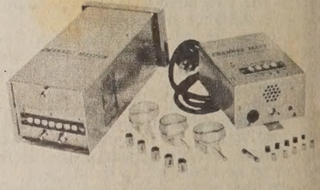

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EQUENCY STANDARD

(Continued from Page 37)

ork between the plate of the {8 and chassis.

our case we found that the signal ie plate of the 6BM8 was exactly olts R.M.S. with the fork oscillator ating correctly and so the two rers marked with an asterisk were ind to provide a suitable division. r value, however, may vary with idual units and should be checked rimentally.

aving set the input at 15 volts, con- a C.R.O. to the square wave output inal and adjust the mark-space ntiometer so that the tops and bot- of the square waves occupy equal th on the C.R.O. screen. Next the pF trimmer capacitor should be add to correct any tendency towards rshoot" which may be present. This r shows as a spike on one corner ie trace.

eaders desiring information on the of a square wave generator for test- amplifiers should refer to the article are Waves for Audio Oscillator" h appeared in the May, 1960, issue.

HEART OPERATIONS

(Continued from Page 14)

flexadil, are now extensively used elax and even paralyse the muscles the body so that the surgeon can k on quiet muscles. This is most ntial in surgery of the abdomen or t, as organs remain in place during operation instead of jumping out to the operating table.

he patient is first given an anaesic named pentothal sodium. This ery rapid and in these cases is given tly. Then enough curare or flexadil njected to quieten the muscles. A is then passed down the windpipe the lungs. Through this is fed a ture of oxygen and nitrous oxide ghing gas). This is the anaesthetic ch will carry on during the opera- .

bag is inserted in the tube line. This is squeezed by the anaesthetist to vide a kind of artificial respiration, ause the lungs have been paralysed the curare.

he chest is now opened and the rt-lung machine connected to the cirition. This keeps the body and brain plied with blood during the opera- .

hus, with paralysed muscles and a t heart, the surgeon operates whilst blood circulation is carried out artilly by the heart-lung machine and ficial respiration is carried out by tube and bag apparatus connected he windpipe.

he effects of curare can be immediy dispersed by injection of a subice called "prostigmin." When this njected the muscles immediately come k to normal. Thus science has pro- d a wonderful tool for use by the geon in heart surgery.

pace does not permit of further dission of this interesting subject. Suffit has been said to indicate the wonful things that can be done to the t vital parts of the human body.

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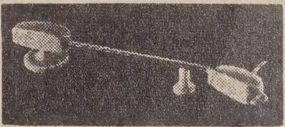

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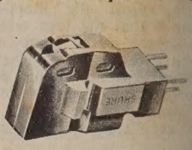

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